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Engineering News-Record

Widening Cut—Queensboro Subway Extension, New York City

In This Issue: Open Cut and Tunnel in Manhattan Schist; Modern Fine-Paper Mill, Design and Equipment; Maintenance Force Reconstruction of Sand-Clay Roads in Georgia; Six pages of Job and Office Articles

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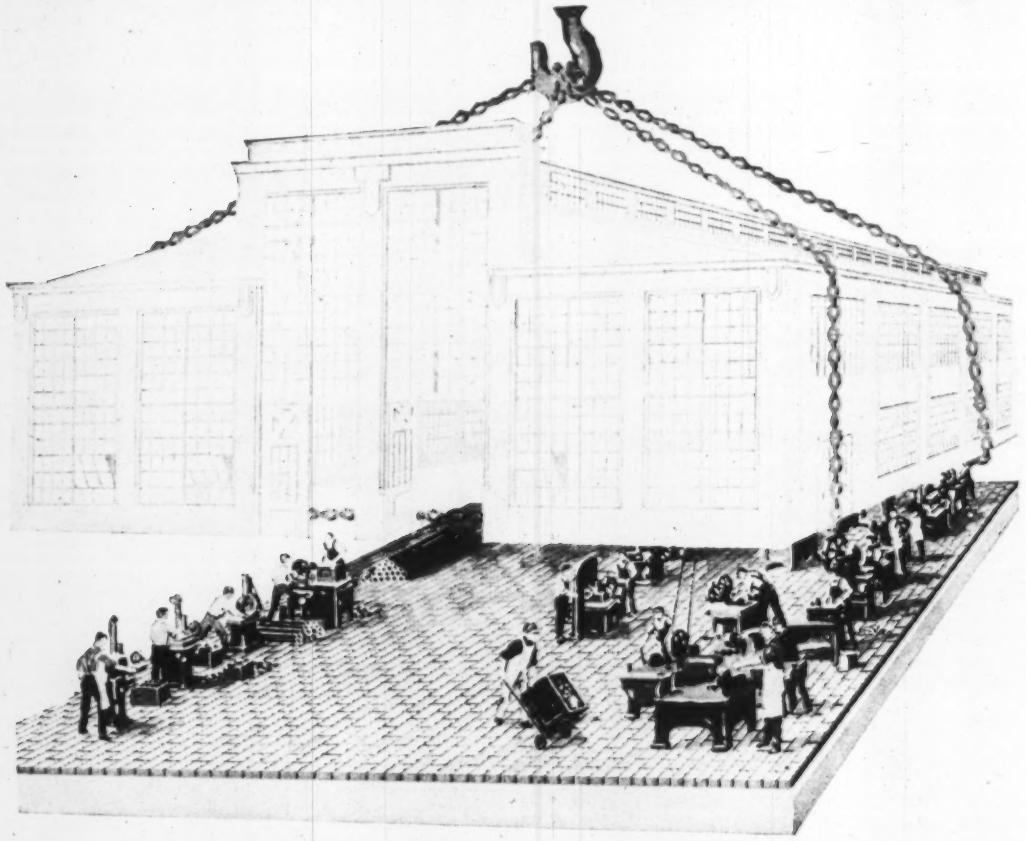

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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Highway Legislation

POLITICIANS again this winter are looking wistfully at the long rosters of positions in state highway departments and planning "readjustments" of laws which will make these positions more available to faithful workers in the political vineyards. In several states in which large funds for road improvement have become recently available, road department reorganization acts are being urged by legislators. In some instances the changes proposed are good—are backed in principle by the best highway thought of state and national authorities on public roads administration. By and large this commendation is not possible. The "reforms" proposed reflect no thought except that begotten by the desire to give the politically faithful ones clear access to the five hundred or a thousand jobs which active state highway departments have to offer. There is no contention here that political appointees are invariably venal. This is not the case. There are many elected and appointed highway commissioners whose concern for the technical tasks of highway construction and operation is much greater than their interest in political currents. But highway administration is the task not only of the specialists but of the specialized organization. It is a labor of years to build up such an organization. Men must be trained and the trained men must be kept until they are skilled in team work. No big business can be otherwise well managed and road construction and operation today is truly big business. Contractors and engineers organizations in every state have this winter the vital duty of watching highway legislation and arousing the business public to the vicious significance of certain trends of legislation.

Complicating Contract Provisions

CONDITIONS which compel subterfuge rarely allow logical action. A straightforward contract, of any of several available types, for the Narrows Tunnel at New York City would have been the simplest of documents to prepare had the engineers been free to act without an artifice to escape debt limit restrictions. Instead we have a contract, as outlined in another column, which is a credit to the engineer's ingenuity but which adds contractual complexity to an operation whose construction intricacies promise ample trial of the utmost cunning of both designer and builder. The conditions which force these contract terms are not of the engineer's making. They are, we believe, deplorable in his sight, and, it is evident, he has made a serious effort to get true competition between contractors and true price comparison between types of tunnel. There is no conviction that he has done either, not through lack of purpose or effort, but because competitive conditions seldom exist in a contingency contract for installment construction, especially if there is the added complication of non-comparable installments of competitive types of structure. Such contracts have the more definite objection that prices must be made high as insurance against their hazards. It is highly unfortunate that the city of New York must undertake construction of the longest subaqueous tunnel under contract conditions which complicate the engineer's problems of design and economic construction.

An Anomalous Tunnel

SINCE the preceding paragraph was written there has arisen some chance that possibly the city of New York may not have to begin the Staten Island tunnel at present and that when it does start it the complicating conditions of the contract may not be present. Mr. Justice McAvoy, in his long report as state commissioner on the transit situation in New York City, devotes some attention to the Staten Island tunnel and adds the weight of his authority to the already obvious fact that this tunnel, attempting to combine as it does the virtues of main line freight and passenger railway tunnel with those of a rapid transit tube, is an anomaly. The city of New York is justified in trying to improve the passenger facilities of Staten Island and to that end might well consider a subway there. Whether it is justified in spending many millions to open up to rail communications its unused piers on Staten Island and to insure through rail traffic into its Long Island boroughs is extremely doubtful. Certainly with its debt limit so near and its transit problem so acute, the arguments are all against now building the freight tunnel—which may possibly carry a few passengers. Justice McAvoy's report may have just the needed weight to postpone construction of the present tunnel and thus save the complications that are bound to result from the contingency contract now being advertised.

Road Contract Failures

WEATHER and management are shown by the records of federal aid road construction to be chiefly responsible for contractors' failures to secure progress and profit in road building. The quoted figures are 33 per cent failures due to weather and 27 per cent failures due to management. On this showing it is assumed that there is small justification for any complaint that "engineers are crowding many contractors to the wall." The figures and the conclusion are both worth attention. Without the inclusion of the causes which contribute the remaining 40 per cent of failures it is not easy to estimate the indictment against contracting management actually contained in the charge that over a quarter of road contracting failures are chargeable to inefficiency of contractors. Management is an elastic term. It would be highly instructive to have the 27 per cent management failures broken down into component items. For

example contractors would be intensely interested in knowing what number of the 27 in 100 failures were contractors who had scant qualifications for successful road building but were the lowest bidders and were backed by corporate surety bonds. There are several other elements having a distinct bearing on our interpretation of 27 per cent efficient management. Later, it is hoped, the federal bureau engineers may be able to analyze their records more fully. It is an important duty. Contractors will be among the first to admit that there have been many inefficient contractors building roads at one time or another. Also they believe they know well enough the main reasons to justify a demand for further analyses of the Bureau of Public Roads records of contract failures before accepting so general an indictment of incompetency.

Winter Construction Data Wanted

BUILDING construction this winter has probably been relatively greater than in many years. In spite of a generally cold and stormy season current report indicates an exceptional volume of work continuously pushed forward. The indication is less clear in other construction operations than building but everywhere it has been observed that contractors were more slow to let frost hamper their operations. As in respect to most factors of seasonal construction, our actual statistics are meager; it is merely opinion based on observation which leads us to conclude that winter construction is particularly active. Except in a few of its relations, here precisely is the lack in all our many animadversions on seasonal construction wastes. We have not the figures. In particular we lack data on the technique of winter work—its hazards, its safeguards; its speed and its cost. Here lies the duty of the engineer and contractor in contributing to winter work extension. They must show the ways and costs. Today our literature on winter construction is a mass of generalties. Let constructors during the next twelve months buttress them with related examples and statistics.

Tied Hand and Foot

NEW YORK STATE is completing a 8,000-hp. hydro-electric power plant at two barge canal dams on the Mohawk River near Albany. The original law authorizing the construction of these plants, enacted in 1922, stipulated that the power be sold to private companies for transmission and distribution to municipalities for municipal purposes only. This seemed bad enough in a community where municipal requirements are largely for lighting purposes and consequently are small and irregular, because it meant that the state could not dispose of the power to best advantage and so have it produce as much revenue as possible to aid in the cost of maintaining the canal. But this restriction was in 1923 further restricted so that the power can only be sold direct to municipalities for municipal purposes and authorizes the state to build transmission lines to the boundaries of municipalities purchasing the power. Representatives of the neighboring cities have now refused to purchase the power, because in the first place, the new power is developed at 60 cycles, while the majority of the nearby cities are still using 40 cycles; most, if not all, of the cities would have to build distributing systems within their city limits if they purchased power from the state; many of them have signed contracts for a number of years to come with the companies now supplying them with power; and, finally, the state developed power, although fairly dependable, is, in effect, secondary power because the canal has a first lien upon the water from which it is developed. When the choice lay between tying up their cities to this small and isolated source of power or continuing to draw from a large interconnected and dependable power system the mayors of the neighboring cities unanimously chose to continue to purchase power from their present source. Enough of the impediments to state owned power are illustrated in this example to make it a worthy exhibit when the next proposal for similar enterprise is brought up.

The Case for Chicago

THE Engineering Board of Review of the Sanitary District of Chicago has just issued, as a printed book of 115 large pages, "The Technical Bases for the Recommendations" of the board as to the procedure of the Chicago district in taking care of its sewage. Those recommendations, printed in full in our issue of Jan. 1, 1925, were reduced to very low terms, and required for proper understanding the data which have now been supplied. On the basis of this elaborate exposition of the three months' study of the 28 engineers of the board an appraisal of their conclusions can now be made.

The board was appointed by the Sanitary District to report "on the lake lowering controversy and a program of remedial measures." The District had reached a crisis in its existence, with its rights to a large diversion threatened by court action, with a tremendous antagonism against that diversion developing in the Lake states and in Canada, and with a proposed federal authorization of diversion approaching in Congress. The District needed authoritative engineering advice, preferably confirming its program and justifying its plan, but in any event laying down the fundamentals on which it might proceed to its appointed end, the disposal of the sewage of the Chicago district. The board was the engineering adviser of Chicago, not of any of the other interests concerned. Its duty was to its client, in so far as its members could maintain their professional impartiality. It would be intruding into the hazardous territory of professional ethics to question whether the report rendered is precisely the same as would have been rendered had these same distinguished engineers been retained by, say, the United States Supreme Court, to report on this same question. We do not purpose, at this time, to make that intrusive venture.

The major problem before it, the board says, was the best utilization of the Great Lakes for the benefit of the United States and Canada. That problem, however, the board approached through the gate of Chicago's sewage disposal problem. In other words, the board chose to visualize the proper utilization of the Lakes as an abstract problem affected primarily by the concrete existence of Chicago's diversion and only secondarily by considerations of existing law or treaty. Here is Chicago, in effect they say, a district of potentially seven million people, on a great body of inland

water, its only source of water supply, and with an existing intersecting stream diverting water away from the main body. How best can the district insure the well being of its people in the disposal of its wastes, and that being once established how will that solution affect other interests?

First, then, the board examines the art of sewage disposal and rejects the proposal made by Chicago's opponents that the sewage of that city when properly treated can be safely turned into the lake from which the water supply comes. It recommends an accelerated and intensive program of sewage disposal, the like of which has not not been even suggested for any other city in the world, thereby confounding the lay critics who continue to assume that Chicago does not intend to purify its sewage, but the board finds that even at the end of this construction program "to continue to discharge the sewage into the lake, however well the sewage may be first treated, would be a backward step, highly repugnant from the sentimental viewpoint and equally objectionable from the point of view of public health." This, it may be contended, is a mere statement, but it is a statement from a board which contains some of the most experienced sanitary engineers of the day. The statement might have been stronger had it been backed by more insistence on immediate purification of the water-supply of the city of Chicago, and an expression of just what the board would recommend to the district if it were required to get along with a lowered or no diversion from the lake. No one of these eminent engineers would dare to say, we suppose, that Chicago would vanish from the map if the Chicago River were to be dammed at its mouth in say 25 years.

However, lake disposal being dismissed, the only recourse is a continuance of the carriage of the sewage —in its treated form—down the Chicago River channel. The continued carriage, and the diversion of the Lake water that it requires, is the thing that is being fought, so the board must proceed to examine its engineering justification.

First, then, this diversion is needed for the Lakes-to-Gulf Waterway. The board does not argue the economic or engineering advantage of that waterway, but merely states it and justifies a 10,000-sec.-ft. flow in it on the savings in first cost and operation, though it is admitted to be operable on a lower flow. Secondly, the board finds that even the treated sewage requires a dilution factor that as far ahead as 1955 will necessitate a 7,700-sec.-ft. flow—because of the algae-producing qualities of treated sewage and the consequent reduction of oxidizing agents in the water. The gap between this figure and the 10,000 sec.-ft. asked is not bridged but the larger amount is justified, though not in exact figures, by brief reference to the flood possibilities from reverse flow and the hydraulic difficulties in the control of the river with a smaller allowed diversion.

A flow of 10,000 sec.-ft. being thus established, its effects on other interests must be inquired into. These consist in a lowering of the Great Lakes of approximately 5 in. and the abstraction from the Niagara and the St. Lawrence of 10,000 sec.-ft. which might be converted into power. To compensate for these admitted losses the board presents a well considered scheme to build at the foot of each of the Lakes regulating works which would restore the levels to heights greater than they have been in years and would insure a uniform flow at Niagara and on the St. Lawrence permitting greater power production than would be possible without regulation even if the Chicago diversion were shut off. This is constructive advice, but the fact is ignored that with such works the levels would be higher and the power possibilities greater still, with that diversion absent.

Finally the report, in justification of the power production from the diversion, makes the surprising statement that a second foot of water in the Illinois valley, with a 122-ft. head, is worth as much for power production as the same amount at Niagara, with a 305-ft. head. This is arrived at by comparing the saving of Niagara over competing adjacent hydro possibilities with the proportionately greater savings of the Illinois waterway hydro plants over competing steam plants, assuming that the cost of the Illinois hydro development lies only in the cost of power houses, the dams and storage facilities being assessed against navigation improvement.

This, then, is the train of the argument. It is inescapable that it starts from the major premise that the Chicago diversion exists and should be utilized. How else explain the fact that there is no published examination of the possible program for Chicago were it required to get along with little or no diversion from the lake? How else explain the almost complete neglect of the possibility of water filtration of a lake water fed a treated sewage? How else justify the glorification of a 10,000-sec.-ft. tributary to a doubtful waterway which admittedly can be operated on 1,000 sec.-ft.? How else, finally, explain the writing off of a part of the power production cost to the credit of this same doubtful waterway?

The board may or may not have believed that Chicago has any present right to divert 10,000 sec.-ft. from the Great Lakes. It was not concerned, apparently, with legal rights. What it saw was a great waterway system covering half a continent, with a great city thereon dependent for the present and for a number of years to come upon a diversion from that body of water, a diversion which at present adversely affects only the navigation of the Lakes and the production of power at Niagara. A continuance of that diversion would measurably benefit the city and possibly benefit the central valley of the United States, and its adverse effects could be readily compensated for for some time in the future. It sought to leave for the future the adjustments the future might require and to justify for the present the continuance of security and benefit the diversion insures.

So long as it keeps to its major concern, that is the need of some flow down the canal to insure Chicago's proper sanitation, the report makes a strong case for Chicago, so strong, indeed, that those interests which would deprive Chicago of its diversion from the Lakes are going to be hard put to it to make an adequate answer. But when the report attempts to justify the full 10,000 sec.-ft. (which amount is not justified in the report by the sanitary requirements) by the demands of the Illinois waterway and the power needs of the valley, it takes on the semblance of a special plea for an arbitrary demand fixed by usage, rather than a disinterested study of the engineering needs of the case.

Open Cut and Tunnel in Manhattan Schist

Queensborough Cross-Town Subway Extension at Forty-Second St., Manhattan, Calls for Careful Methods in Safeguarding Crossing Tunnels and Water Mains

UNDERGROUND railway construction in its most difficult aspects is illustrated by the work now well advanced on the Queensborough Subway extension across-town at 42nd St. in New York. Abutting buildings, contiguous water mains and sewers and other subways running above or across introduce exceptional hazards while heavy rock excavation and the erection of steelwork and concrete placing below busy streets without hindrance to traffic or annoyance to business demand the construction in detail which characterizes subway building under city streets. It is as a series of special operations, therefore, that the new cross-town rapid transit line has to be considered.

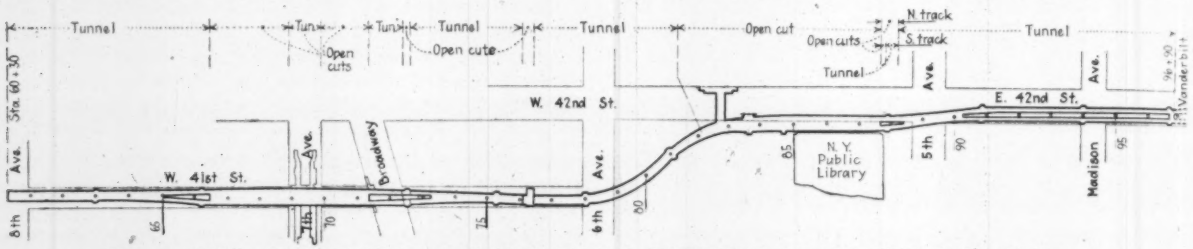


FIG. 1—ROUTE MAP OF QUEENSBOROUGH SUBWAY EXTENSION ACROSS-TOWN IN MANHATTAN

Route and General Plan—The route of the new subway is shown in diagram by Fig. 1. The Queensborough subway from Long Island crossing the East River on the line of 42nd St., Manhattan, terminates at Vanderbilt Ave. Its train terminal is the Park Ave. and Grand Central Subway Station. From here, west across-town to the Broadway and the Seventh Ave. Subway Station at Times Square, the transfer of passengers has been by shuttle trains accommodated by taking over the 42nd St. spur of the Seventh Ave. Subway. This shuttle train service has grown inadequate and besides it requires a change of trains. The new line is intended to relieve the congestion and delay by providing a parallel cross-town route. It is an extension west of the Queensborough subway which provides through train service between Times Square Station (Seventh Ave. and Broadway) and Queensborough. The traffic services of the new line need not be further indicated except to observe that there is an intermediate station (between Times Square and Grand Central) at Fifth Ave.

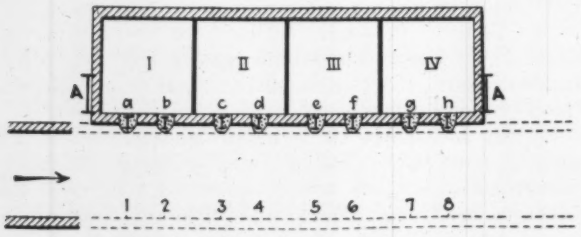


FIG. 2—DIAGRAM OF PROCEDURE EXCAVATING UNDER CROSSING SUBWAYS

Turning to the map, Fig. 1, the route, stations and sequence of open-cut and tunnel construction are clearly indicated. In detail the construction required is as follows: From the old Steinway tunnels terminal, 74 ft. below street grade, twin tunnels on a rising grade extend to a little west of Fifth Ave. From the ends of the twin tunnels west something over 500 ft. is open-cut emplacement for the Fifth Ave. station. Here the depth to subgrade is about 45 ft. Then comes double-track tunnel under the corner of Bryant Park and Sixth Ave. and along 41st St. to near Broadway. An open-cut station excavation carries the work to about midway between Seventh and Eighth avenues. Thence, to a dead end at about the middle of Eighth Ave., is double-track tunnel. At Seventh Ave. the depth is about 55 ft. There are in tunnel and open cut 226,000 cu.yd. of excavation of which 189,000 cu.yd. are rock. The total length of the line is 3,660 ft.

From the outline of the work, it will be observed that subways cross over the new line on Seventh Ave. and on Broadway and for the distance that the new line is within 42nd St. Where the line skirts the Public Library building and in 41st St., where it fills the street between curbs, there are contiguous building foundations to be considered. Crossing sewers and water mains furnish a third type of hazard. The ways of meeting the hazard in each case indicate general procedure also.

Sewer and Pipe Crossings—The most important conduit crossings under-run by the subway have been a 6-ft. sewer between Vanderbilt and Fifth avenues and four lines of 48-in. water mains at Fifth Ave. In the case of the sewer the cover over the excavation to the bottom of the sewer was 4 ft. There was a 10-ft. cover between excavation and the water mains. Somewhat different methods of driving underneath were adopted in the two cases, both however based on the theory of close shallow holes and light blasts.

Under the sewer the construction was parallel twin tunnels, with a separating rock core and inside structures of steel bents with concrete arches between them. The cut for each tunnel was 16½x17 ft. It was normally taken out in a heading about 20 ft. ahead of the bench and in a bench 7 to 9 ft. high. On approaching the sewer short holes were put in close together and light charges were fired. This broke out the rock in small pieces and reduced the blasting shock and shattering to insignificant amounts. Moreover the bench was kept close to the heading and the lining was kept snug up to both.

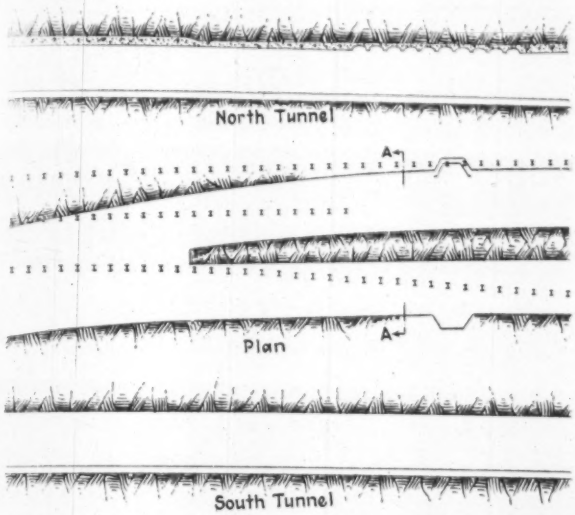


FIG. 3—LONGITUDINAL RELATION OF OLD AND NEW SUBWAYS ON 42ND ST.

In case of the water mains in Fifth Ave. a bottom heading 9x8 ft. was driven and enlarged. Using many short holes the sides of the heading were widened and the roof was raised by many small blasts. The dynamite was 60 per cent. Virtually the roof rock was pealed off in layers. This procedure with a 10-ft. cover hardly shook the water mains. It should be noted, however, that in case of both sewer and mains the underlying schist rock was hard, dense and solid.

Besides the mains there had to be passed, on the west side of Bryant Park, a shaft to the pressure tunnel under Manhattan of the Catskill aqueduct system. Both shaft and tunnel are filled with water under pressure. From the side of the tunnel to the side of the shaft was 30 ft. Ordinarily in the heading 26 to 28 holes were used. In passing the water shaft the number was increased to 126 largely on the side and crown nearer the shaft. The heading on one side was in effect line drilled and wedged out by light blasts.

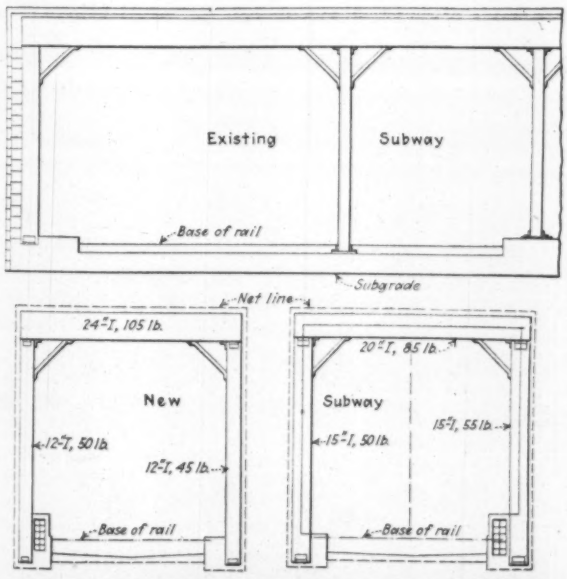


FIG. 4—TRANSVERSE RELATION OF OLD AND NEW SUBWAYS ON 42ND ST.

This cross-section is located at about A-A on Fig. 3.

Subway Crossings—Illustrating, even better, blasting in detail as a means of under-running other structures, are the Seventh Ave. and the Broadway subway crossings and the shuttle line on 42nd St. east of Fifth Ave. Considering first the direct crossings as the more simple, the general under-crossing procedure has been developed as indicated in diagram by Fig. 2.

At the crossing the roof of the new tunnel is up against the floor of the old tunnel. As the side wall of the old tunnel is approached the rock is removed for the insertion of plate girder *A* spanning the new cut and carrying the side wall of the old subway. Then entrance is made to the old subway and beams *a* and *b* are set under the rails and spanning the new cut, and are encased in concrete. Driving is then begun using many holes and light charges until the face is removed so that columns *1a* can be erected and the lining placed. Driving ahead, columns *2b* are put in. Then beams *c*

FIG. 5—DRIVING NEW SUBWAY UNDER OLD SUBWAY ON 42ND ST.

and *d* are installed and driving and lining proceed until track II is supported. By the same process tracks III and IV are under-run.

In 42nd St. the relation of the new subway to the shuttle line above is shown by Figs. 3 and 4. Here the new structure is parallel twin tunnels. As shown by Fig. 5, a bottom heading driven from both ends was put through in each tunnel. Then the roof was raised by close, shallow holes and light blasts keeping the lining structure erected close up to the face. The illustration indicates the character of the rock which here is dense, solid and hard. Construction has proceeded past the point of thinnest cover between the new subway roof and the old subway floor and from this point on the cover will thicken. It is, however, considered by the engineers of the Board of Transportation that to proceed by this method introduces too great a hazard to the operating subway and excavation has been ordered stopped, although the contractors, with a large bond to guarantee security, had so arranged the work that,

with a 4-ft. solid rock lintel, overhead, the superimposed load of the old subway columns would in no case be more than 15 in. from direct support beneath. The contractors have acceded to the engineers' demand, but presumably will require compensation for the resulting delay and extra expense.

In the cut for the Broadway-Seventh Ave. station the street had to be kept free for traffic. Plate girders were used to span the cut. They were held up at the ends by posts standing on the rock, and carried a timber flooring. As at the Fifth Ave. cut, the plan was to keep the cut as free as possible from timbering. In general this is the outstanding feature of all the work, tunneling as well as open cut.

Driving Tunnel—Where the excavation is two parallel tunnels—east of Fifth Ave.—

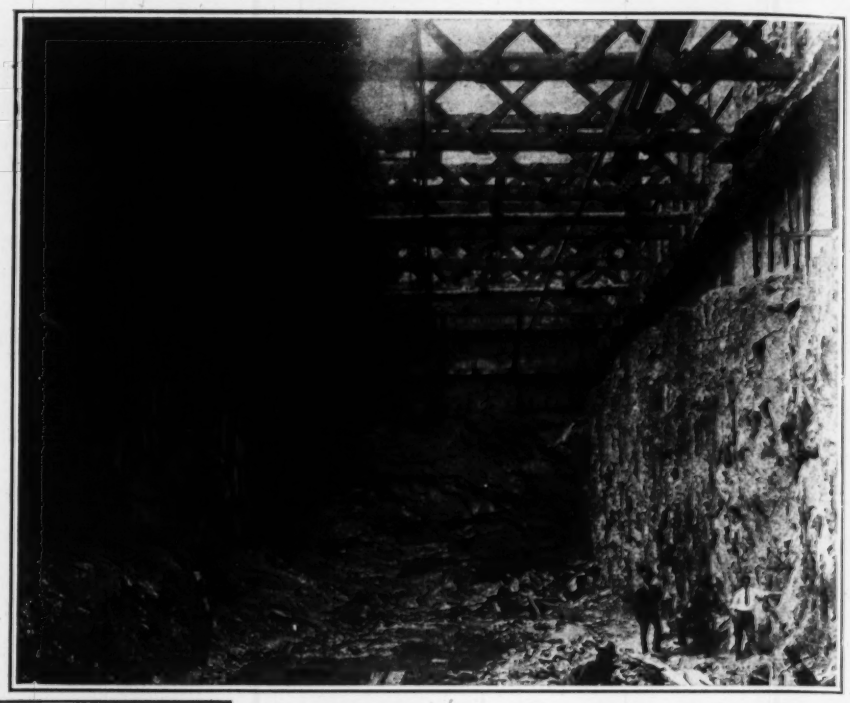


FIG. 6—OPEN-CUT EXCAVATION BESIDE PUBLIC LIBRARY

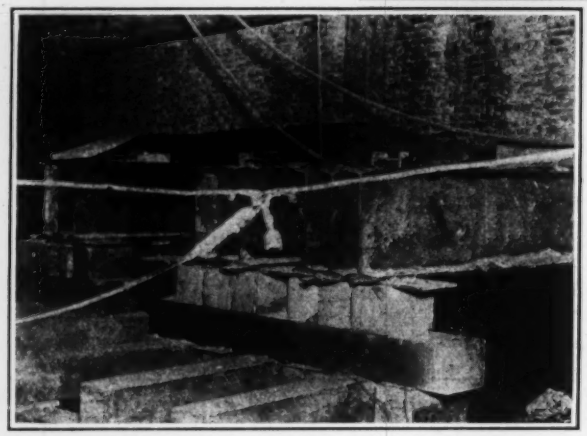


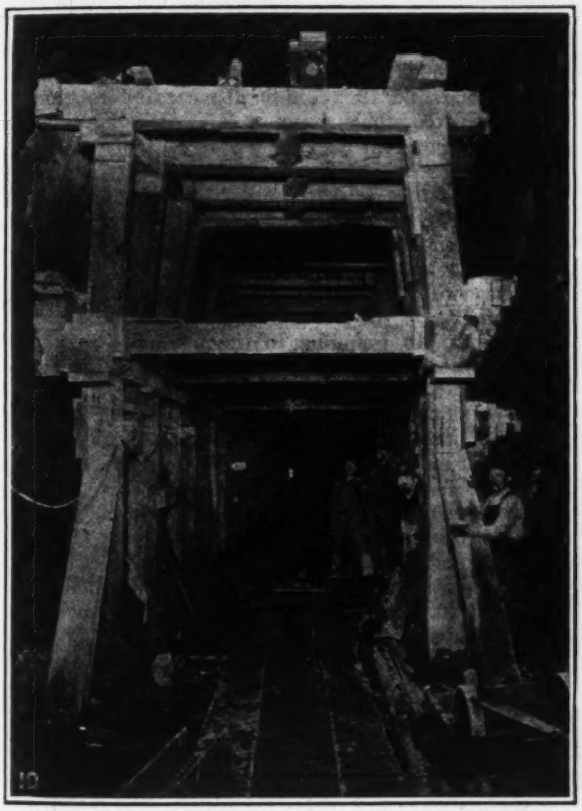
FIG. 7—UNDERPINNING VAULT AND BUILDING WALLS OF A THEATER ABOVE THE LINE OF WORK

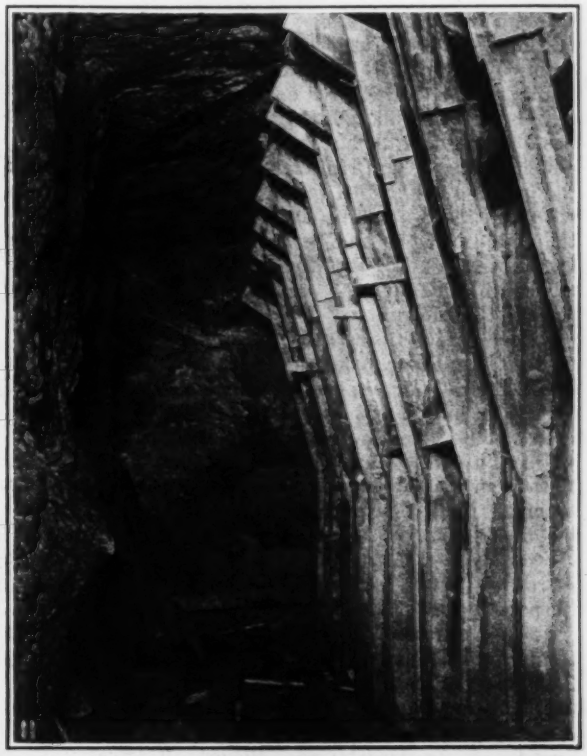
a top heading of about half of the 16½x17-ft. section was driven using 53 holes 2 ft. deep. A shot took out 6 or 7 ft. The bench was kept 20 ft. behind the heading. The drills were 2¼ in. to 1⅜ in., with ⅛-in. drop for each change of steel. A heading round required about 65 steels and a bench round required 20 steels. As has been described this normal practice was changed when under-running conduits and subways.

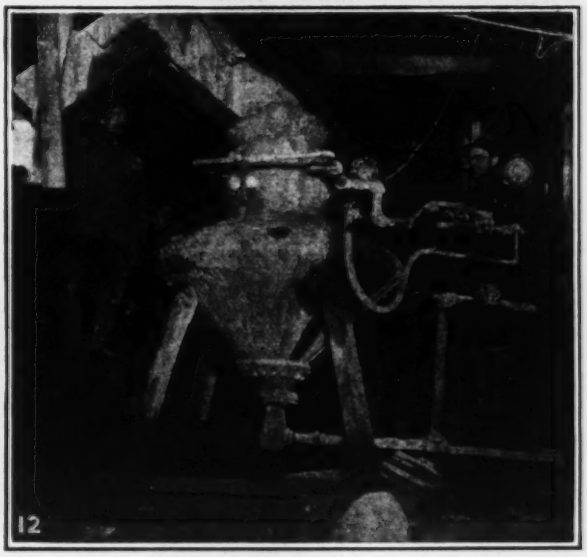
Under Bryant Park and 41st St. the tunnel was largely umbrella section—that is, two arches carried on center and side walls. Generally the rock was hard, although seamed, but in one place for some distance it was rotten. There have been variations in detail but in general the process has been to drive a top heading, Fig. 9, and then deepen it to form a center cut, Fig. 10. In this center cut the forms for the center wall and its umbrella top were erected, Fig. 11, and filled. Widening out then began in such manner that the roof arches could be put in resting on rock benches at the sides. Finally the rock benches were taken out and replaced with concrete, thus completing the side walls. The method cut down timbering, gave quick permanent roof support and left the space below the roof remarkably clear for hauling and other work. It was adopted as a particularly safe method in uncertain rock.

Placing Concrete—All concrete has been placed by compressed air. This process has been found by the contractors to have particular merit. The pipe line takes up little room and it can be nosed into almost any space to be filled, even close up to the excavation. Examination and test show the concrete to be dense and uniform. The delivery in small batches is pecu-

FIG. 8—CLOSE DRILLING IN ROCK CUT UNDER PUBLIC LIBRARY WALL







FIGS. 9-12—OPERATIONS OF TUNNEL DRIVING AND CONCRETE LINING METHODS

Fig. 9—Top heading with men drilling bench.
Fig. 10—Bench excavated and full cut timbered.
Fig. 11—Forms for center wall and umbrella top.
Fig. 12—Pneumatic concrete placer in operation.

liarly adapted to concreting generally small-volume units.

Three concreting plants have been operated, two of ½-cu.yd. and one of ¼-cu.yd. batch capacity. All are located in the excavation and the arrangement is alike for all. At the street surface there is a hopper into which trucks dump sand and stone. The hopper delivers the aggregate into a sand bin or a stone bin below the surface. These bins have side gates which deliver into a measuring hopper. Cement chuted in bags from the street surface comes to the measuring hopper platform and is there added to the stone and sand batch. The measuring hopper empties into the mixer on a staging beneath. In turn the mixer discharges into a hopper and closed chute to the body of the compressed air concrete gun.

Essentially the gun, as shown by Fig. 12, is a conical drum with charging and discharge connections and with valves and air connections. When charged with concrete the proper valves are operated, air is turned on and the batch is forced out of the drum and driven

through the discharge pipe line to the point of deposit. In the subway operations the air pressure has ranged from 65 to 80 lb. It has been possible to shoot a batch a minute. With the three outfits 160 cu.yd. of concrete have been placed in a shift. A 6-in. discharge pipe line has been used in all instances. The maximum delivery which the work will require is 1,500 ft. So far one of the larger guns has delivered through 1,160 ft. of pipe, with nine right-angle bends, to a height of 57 ft. above the drum. At the end there was a vertical lift of 24 ft. It will be noted that the gun is not depended on for any mixing action, it is simply a device for delivering concrete already mixed in the regulation manner.

Power Plant—Compressed air is furnished by a plant on the East River front at about 42nd St. There are two electrically driven compressors, one direct-connected 14 and 22 in. x 20 in. with a capacity of 1,600 cu.ft. of free air per minute and one belt-connected 10 and 16 in. x 14 in. with a capacity of 660 cu.ft. at 80 lb. These compressors operate the drills, pneumatic tools, concrete guns, hoists and pumps. The mixers are motor-operated.

Personnel—Contract for construction was awarded April 21, 1922, to the Powers-Kennedy Contracting Corporation of New York, A. J. Powers, president, John J. Kennedy, treasurer and general manager, and Henry L. Kennedy, general superintendent. Albert Carr was engineer for the contractor during the early part of the work and on his death Henry B. Seaman was engaged. The direction of the work is under the Board of Transportation, Robert Ridgway, chief engineer.

Checking Slides and Washouts on Railways in India

Rubble Retaining Walls With Fills and Drainage Wells Protect Tracks—Streams Diverted Through High-Level Culverts

VARIOUS methods of dealing with slides and washouts on hilly sections of the railways in India are described in communications to the Institution of Civil Engineers by T. R. Nolan and E. W. Stoney, two members of that society. On the Nilgiri Mountain Ry. the slides at one time were so numerous that the line was closed to traffic for seven months, and 59 major slides occurred during that amount of time. These consisted of boulders, rock and earth of an estimated volume of 200,000 cu.ft. in one year and 140,900 cu.ft. in the year following.

The Nilgiri Ry. passes through rough country where the cuts have steep slopes, rendering them liable to slides. It is thought that the blasting in these cuts during construction opened fissures and loosened cleavage planes in the rock for some distance back from the face; and that, although during the dry season this could not be detected, the monsoon rains filled the fissures with water, and caused the material to slide on the sloping solid rock, and to crack away in masses. The rainfall in this neighborhood varies between 1.70 in. in May to 16.29 in. in October.

At one point the line crossed a small ravine with rock sides on a 28-ft. span bridge. A boulder weighing not less than 50 tons became dislodged above the line and rolled down the ravine, bringing with it an avalanche of some 3,000 cu.ft. of boulders and rock. The first boulders appeared to have fallen on a rock shelf above this bridge, and then to have struck the side of the girder, hurling it down the ravine, where it rested bottom up with the boulder broken into two pieces lying against it. The masonry of the abutments was shattered, and the permanent way was thrown over and very much damaged for about 100 ft. on each side of the bridge.

In avoiding slides Mr. Stoney devised a plan whereby trenches were dug 50 ft. apart and about 5 ft. wide from the face to the back of the slides and down to formation level. Trenches were then filled with rock and small boulders. These insured good drainage and held up the earth between them by friction. No trouble has been experienced in any case where this method was employed.

The first wall, of the section shown in Fig. 1, was destroyed about 18 months after it was built. The wall which replaced it (Fig. 2) was then designed by Mr. Stoney. Great attention was given to the thorough drainage of the sloped earth behind the wall, a wide backing of trap boulders being filled behind as the wall was built. In addition, a well of 6-ft. inside diameter was built 109 ft. from its lower end. The wall is 417 ft. long and 13 ft. high above rail level, and is constructed of rubble masonry laid with lime mortar, and founded on stiff clay.

The hill section of the Assam-Bengal Ry., since its opening to traffic in 1915, has been subjected to numerous slides, subsidences and washouts; those which occurred in 1915 were of such magnitude that the section, 115¼ miles in length, was closed to traffic for two years while repair work was carried out. The hill section traverses the North Cachar Hills from Badarpur in the south to Lumding in the north. The highest point reached is the Jatinga saddle at 1,856 ft. above sea level. The rainfall ranges from 150 in. on the southern slope of the hills to 40 in. on the northern. Local falls of 30 to 40 in. in a week are frequent. The hills are of tertiary formation and consist of alternating beds of carbonaceous shales and sandstones. The rocks are so fissured and crushed by earth movements that they easily break up into fragments on exposure, and, too, the country is subject to earthquake shocks.

For checking slides in wet cuts drainage headings are employed. These headings, located as circumstances require, have been placed at depths exceeding 40 ft. below the surface. The headings, when completed, are filled with rubble. Drainage of cut slopes by fan- or Y-shaped drains of small dimensions was ineffective, so they later were constructed in many cuts to depths of 16 to 20 ft. These drains are generally supplemented by heavy toe walls, and where the ground underneath the formation is bad, these toe walls are buttressed by inverted arches.

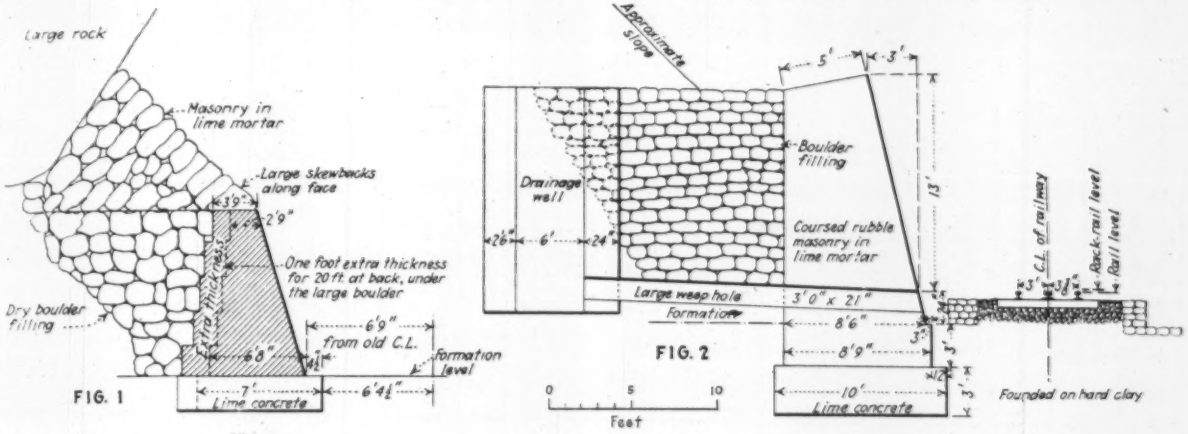
Where the shale strata lay more or less horizontally it was found sufficient to face the shale beds with dressed dry stone pitching. If they were not so protected, disintegration rapidly took place. In some cuts shale beds over 100 ft. in depth on the exposed surface were thus protected, but masonry pillars with flying arches between them were used to support the skin of pitching where the height was great.

In one place the line is subject to undercutting below by the Jatinga River and to slides from the overhanging hill. The trouble has been overcome by building a heavy retaining wall in the river bed and pro-

tected by a horizontal mattress of wire network with rubble and a reinforced-concrete way, carried on a concrete viaduct. The foundations of the outer side of the covered way and viaduct had to be carried 50 ft. below formation to obtain a solid enough base upon which to build.

The stream diversions dealt with mostly lay above the railway and carried diverted streams through high-level culverts. Many of these had to be converted into covered waterways to obviate blocking by slides, as many large embankments were lost when diversions became blocked, and the streams overran the embankment.

Embankments gave trouble through subsidence with each succeeding monsoon. Many of these embankments crossed valleys where the streams had been diverted to high-level culverts. Complete systems of catch-water drains with baffle walls in the old stream beds failed



FIGS. 1 AND 2—OLD (FIG. 1) AND IMPROVED RETAINING WALL DESIGNS FOR AVOIDING SLIDES

of effect, as also did attempts at drainage at the toes of the embankments. The trouble was traced to the existence of numerous springs on the ground surface underneath the embankments. The problem was solved by the construction of deep drains in open cuts or by drainage headings through the body of the embankments.

At several bridges piers were displaced as the result of landslides. Where the displacement was not more than 2 ft. or 3 ft. the ground below the foundation was drained by headings. Piers so dealt with are up to 80 ft. in height. In some cases this drainage was supplemented by underpinning the piers. At one spot the piers carrying one 100-ft. span and five 40-ft. spans were all displaced by a landslide some 6 ft. in a diagonal direction. The bridge lay on a 10-deg. curve, and the track was about 100 ft. above the river bed. This bridge was replaced by a single bowstring span of 350 ft.

Difficulty was also experienced through blocking of stream diversions leading to high-level culverts with debris carried down by floods. Large sumps were therefore constructed to catch debris, grills of old rails were built across the stream beds, and subsidiary flood embankments were built higher than rail level.

Various forms of protection against river erosion were adopted, and wire network "sausages" filled with rubble were extensively used. At one point, where the river was undermining the railway and causing extensive slipping on the hillside above, the river was effectively diverted by means of a groin protected by sausages. This groin was 700 ft. long, and consisted of a core of river boulders faced on the river side with sausages 60 ft. long of oval section 4 ft. by 5 ft. These were laid transversely to the axis of the groin, each sausage being securely lashed to others nearest it, and the whole formed a mattress 700 ft. by 60 ft. The top of the groin stood about 15 ft. above the river bed, and the mattress lay partly on the groin slope and partly on the river bed. The river here is several hundred feet wide, and runs from 12 to 15 ft. deep in floods.

At minor erosions sausages were laid parallel to the stream. They were placed one above another on the slope of the river bank, and at the toe an additional sausage was laid on the river bed to act as a buffer against boulders washed down by the floods. When very heavy erosion was experienced or expected concrete protection work was largely used, the blocks weighing from 10 to 20 tons each according to the strength of the current. In some cases they were put in in much the same way as blocks in a sea wall. In others they were placed regularly as slabs on the slope of the river bank. They were cast in place in sizes ranging from 4x5x6 ft. to 4x10x10 ft. Where the slope to be protected lay in permanently deep water, a berm of loose soil and rubble was thrown up on the water, and blocks were cast on the top of this. This berm was soon washed away, and the blocks settled down into their final positions on the slope below water level.

The cost of the repair of this line was £228,200.

New Port and Canal Projects for Paris

The council general of the department of the Seine has voted a credit of 11,800,000 francs for enlarging the Ourcq canal as it enters Paris. There will be established at Pantin a dock of 978 m. in length with a width running from 36 to 65 m. These dimensions will permit the easy handling of the largest canal and river barges in use. Other connecting waterways will be enlarged to a width of 17 m. which will permit the ready crossing of boats of the largest current dimensions. There will be a depth of water of 3 m. 30 cm. Dredging will be undertaken at all points where these waterways enter Paris. A tax of 50 centimes per ton will be imposed on all merchandise loaded or landed within the zone where this work has been carried out. The growing traffic of the St. Denis canal has brought about an agreement with the municipality of Aubervillers for the creation of a port at the Aubervillers lock.

Maintenance Force Reconstruction of Sand-Clay Roads

Organization Typifies Georgia Practice—Tractors, Graders, Drags and Light Trucks Used—Cost Very Moderate

By H. J. Friedman
Maintenance Engineer, Savannah Division, State Highway Department of Georgia, Savannah, Ga.

In GEORGIA the State Highway Department was confronted at the beginning of the year 1922 with the task of maintaining its 6,000-mile state system of roads. The funds for the work were limited by law to that portion of the motor vehicle tax remaining after the department's overhead and engineering expenses had been met. This left less than $200 per mile per year for maintenance, in which it was neces-

RECONSTRUCTED SAND-CLAY ROAD IN GEORGIA

sary to include the cost of getting together an organization and securing proper equipment.

The character of the roads included in the state system ranged from properly-constructed, hard-surfaced highways through gravel, top-soil, sand-clay, and earth roads to mere trails through the woods. The sand-clay and top-soil roads, however, represent the bulk of the mileage. In the case of the hard-surface roads, the task was the definite one of maintaining them in the same condition in which they were taken over from the counties. In the case of the unsurfaced roads, there was little to be done except to make bridges safe, eliminate dangerous points and bog holes and await the construction of real roads which under the department's state program was scheduled to precedence at these points.

The problem rested in the maintenance of the sand-clay and top-soil roads. These roads had in the main been built by the individual counties and without engineering supervision or standards of any kind. The result was that where the county road organization was efficient the roads were good, and where the county road organization was poor the roads were likewise poor. The width of roadbed varied according to the ideas of the individual county road superintendent; in some cases county bridges were fair, in others poor, and in many cases there were no bridges and it was necessary to use fords; culverts were largely noticeable by their absence; surfacing varied in quality in accordance with the local material, and of systematic maintenance there had been practically none.

Organization—For maintenance, each of the nine divisions of the State Highway Department was divided into sections averaging 50 miles of road each. This made an average of 12 sections per division. For the first year the crews in these sections operated on conventional maintenance work—cleaning ditches, repairing bridges and culverts, patching surface, dragging, and light machining. While this work, being systematic, showed results in the better general road conditions, the inherent defects—varying widths of roadbed, dangerous curves, low fills, poor surfacing—still remained, and it became apparent, as the construction program of the state, due to lack of funds, was progressing too slowly to remedy the situation, that some method of bettering the highways and making them uniform was essential as a supplement to the actual maintenance work.

The method of handling this betterment work in the Savannah Division will be followed. As this work is closely co-ordinated by the state highway engineer, the following description may be considered typical for betterment operations throughout the state.

The Savannah division comprises 602 miles of state highway through 15 counties. Most of the mileage consists of sand-clay road and all betterment work was done on this type.

Each of the 12 maintenance sections of the division was assigned a typical crew of a patrolman in charge who acted as tractor operator, a machine man, and three laborers. Typical equipment consisted of a tractor (2-ton or 5-ton), two 8-ft. road machines, two 8-ft. road drags, one 1-ton truck with dump body and high-speed gear, and the usual small tools.

For betterment work, three crews called heavy out-

SCARIFYING WITH GRADER AND TRACTOR
Here a 10-ton crawler tractor is pulling a 10-ft. grader equipped with scarifier.

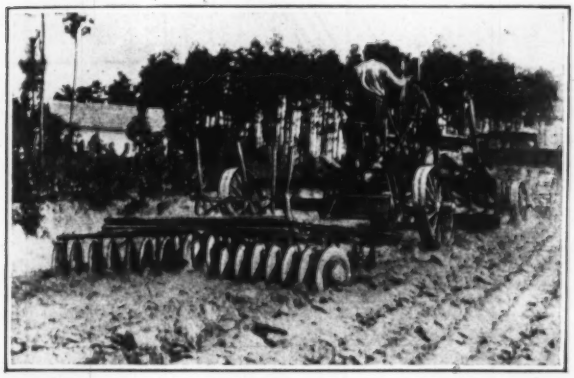
fits were put in the field. Personnel of these outfits was a foreman, who acted as machineman, a tractor operator and three laborers. On the maintenance crews the patrolmen were selected for their mechanical ability and trained on the work in their road duties. On the betterment work, however, the foremen were picked men, selected for their road-building ability. Invariably their experience had been acquired in the county road organizations, and they were assigned to those sections where they were thoroughly familiar with local road conditions, as to drainage, surfacing material, etc. The equipment for each outfit averaged: one 10-ton tractor, one 12-ft. road machine, one 10-ft. road machine, two 1-ton trucks with low-speed gears and dump bodies, and one set of small tools.

Operation of Force—When a heavy outfit strikes a section, the regular maintenance force on that section automatically comes under the direction of the heavy outfit foreman and is at his disposal for working with his crew. This outfit working with the heavy outfit practically doubles the effective force and equipment of the heavy outfit.

Immediately after a rain when the roads must be dragged, or in the event that some urgent maintenance work is to be done, the regular maintenance crew separates from the heavy outfit for that purpose. At all other times it is to all intents an integral part of the heavy outfit. In some cases where the character of the work warrants, two neighboring section crews and their equipment combine with the heavy outfit.

As the condition of the road varies constantly, and as the foremen in charge of the heavy outfits are capable, experienced men, the detailed direction of the work is left largely in their hands. They are advised the width of road to be constructed, the amount of surfacing to be placed and the drainage features to be considered. Except in cases of relocation they are not furnished stakes for line or grade.

In starting work the outfit first organizes a soiling unit. This consists on an average of three trucks. This unit is used both for removing excess sand and for placing



SCARIFYING AND DISK HARROWING IN ONE OPERATION
The 10-ton crawler tractor hauls in train a 10-ft. scarifier grader and a disk harrow.

sand-clay material as required. In removing the excess sand, the cut ditches are first pulled to a uniform width by the 10-ton tractor and grader and the sand from the ditches together with the excess sand from the road surface is bladed into two windrows on either side of the center of the road and far enough apart to permit the trucks to pass between. The trucks are loaded by hand labor from the windrows and the material is used in flushing fills, etc. It has been found that in any method of pushing excess sand to the side of the road, by use of a grader, or in shoveling it to the adjacent ground by hand, the sand eventually finds its way back to the road. The removal of the sand in trucks is found to be more satisfactory and by the double windrow method good progress is made in loading.

After the excess sand has been removed for the section being opened—usually the work is done in two-mile sections—the work of placing the additional clay surfacing is started. In this work, the question of securing easy, rapid loading conditions is a big factor.

It has been found that time was lost in loading trucks, mainly through having to pick by hand the material to be loaded. This material usually is found adjacent to the road at the higher points. By throwing up a roll of this material with the tractor and grader, the work of hand picking is dispensed with and the material in the roll is so broken up that it can be shoveled into the trucks by hand in a remarkably short time. Another method is to scarify the surface in a

FINAL SURFACE DRESSING WITH GRADERS
The 10-ton crawler tractor hauls in train a 12-ft. grader and a 10-ft. grader with moldboard extension.

cut where the material is good and load it directly into the trucks. By so doing there is the additional advantage of lowering the grade in the cut.

In placing the additional surfacing on the road it has been found best to run it in two rows, one on either shoulder, the thickness being varied in accordance with the amount of additional material that is required. This permits travel to use the center of the road without discomfort and the material is so placed on the shoulders that after scarifying it can be pulled to the center of the road as desired. After the surfacing is placed, it is leveled off with the tractor and grader. The ditches are then pulled, after which the scarifier is placed on the road grader and the surface thoroughly scarified to a depth of 4 to 6 in. Usually four to six rounds of the scarifier are required, the scarifying being carried to the shoulder of the road. The broken-up material is now thoroughly cut up with a disk harrow, weighted down and pulled by the 5-ton tractor. The blade is then replaced on the grader and, using the 10-ton tractor, the surfacing material is pushed heavily to either shoulder where it forms a roll with the material pulled from the ditches. This roll is pulled back evenly across the road with the blade grader and the cut ditches are then lightly pulled to secure a uniform shoulder. The surface is then bladed again to cut out any minor irregularities and to secure the proper crown. Proper crown is difficult to secure and no arbitrary rule can be made as to the correct amount to be used. A safe rule is to get as much crown as possible to secure proper rainfall runoff but not to crown so much that the surface will cut with drainage corrugations. In this final blading of the surface particular attention is paid to the superelevation of curves, a feature almost entirely neglected on county work.

The road surface is now in shape for setting up, which usually takes place after the first rain.

The drainage details are now handled. A force is put to work, opening up culverts and culvert ditches, repairing bridge decks, cutting drainage ditches and flaring out the ditches from the ends of the cuts.

After the first rain, the heavy tractor with grader again goes over the surface and is followed by the 5-ton tractor with two road drags. The road is then turned over to the section crew for maintenance.

The heavy outfit work is done in two-mile units as the scarifying of the surface makes travel difficult and a two-mile section can usually be scarified and put in passable condition the same day.

The heavy outfit usually starts at one end of a maintenance section and working by two-mile units continues through the section. Where it is necessary to make line changes, raise fills, or widen cuts and fills involving any large quantities, the work is handled under conventional road-building methods.

In the past year the Savannah Division has scarified and rebuilt 200 miles of sand-clay road in the manner described at an average cost of $125 per mile. The resulting road, while not up to the standard of a construction project, is worked to a uniform width, well drained, with dangerous points and hog holes eliminated and has a good-riding, all-weather surface.

New Tests of Loss of Head in 2-In. Black Wrought-Iron Pipe

General Agreement Shown with Results Obtained by Davis, Saph and Schoder and Various Earlier Investigators

By Lynn Perry
Civil Engineering Department, Lafayette College, Easton, Pa.

RESEARCH work now in progress in the hydraulic laboratory at Lafayette College has required the accurate determination of the loss of head at various velocities in new standard black 2-in. wrought-iron pipe. This work has verified the results obtained by Saph and Schoder and G. J. Davis, Jr., on pipes of the same size (*Transactions* Am. Soc. C. E., Vol. LI, p. 253 and Vol. LXII, p. 97 respectively). The well-known formulas which are so frequently used either as diagrams or as tables usually err slightly on the side of safety, which probably takes care of five to ten years' service and some bends and valves in which the loss of head cannot be accurately forecasted.

TABLE I—LOSS OF HEAD IN 2-IN. BLACK WROUGHT-IRON PIPE, AS SHOWN IN LABORATORY TESTS

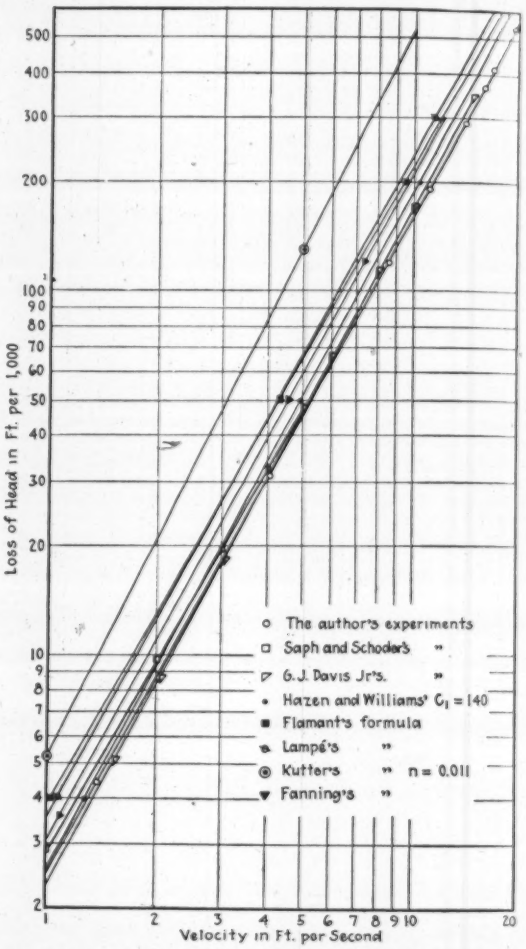
No. of test	1	2	3	4	5	6	7	8
No. of observations	17	10	17	17	12	12	10	11
Velocity, ft. per sec.	1.365	4.100	8.650	11.10	14.10	15.8	16.85	18.9
Loss of head, ft. per 1,000 ft.	4.45	31.15	119.3	192	289	364.1	417	542

The piezometer connections were made carefully and were just flush with the inside of the pipe, and 38 ft. apart. The velocity was obtained by carefully determining the average area of the cross-section of the pipe, measuring the discharge, and computing the velocity from the well-known relation, $Q = AV$. The mean area of the pipe was determined in the orthodox manner, by weighing it, filling it with water, and reweighing to determine the weight of water contained. From the weight and temperature, the volume of the column of water was figured; the length being known, the mean cross-sectional area was computed: in this case 2.067 in. inside diameter. The water from the pipe was permitted to discharge into a previously calibrated tank where the volume discharged could be read accurately.

TABLE II—LOSS OF HEAD FOR VARIOUS VELOCITIES

Velocity, ft. per sec.	1	2	3	4	5	6	7	8
Loss of head, ft.	1.5	8.7	18.2	30.5	45.8	63.5	84.0	107
	9	10	11	12	13	14	15	16	17
	132	160	191	225	260	300	339	380	425

Measurement of Loss of Head—The loss of head due to friction has been investigated extensively and the consensus of opinion among engineers is that the measurement of velocity and discharge, in this connection, has been reasonably accurate. The prevailing weak point in such investigations has been the measurement of the loss of head due to faulty piezometers or piezometric connections. As indicated above, every care was taken to have the connections properly made. The difference in pressure was read from an oil gage when the loss of head was small and from a mercury gage when the difference was beyond the limit of the oil gage. The specific gravity of the oil and mercury were measured carefully and temperatures of the water taken at each calibration to insure results as accurate as possible. A total of 105 observations for loss of head were made with eight different velocities (1.365 to 18.9 ft. per second) covering the usual range above the critical velocity. The laboratory results are shown in Table I. For comparison with other data, Table II shows the loss of head in terms of velocity.



LOSS OF HEAD IN 2-IN. WROUGHT-IRON PIPE

Comparison with Other Results—The accompanying diagram shows these results plotted with velocities as abscissas and loss of head in feet per 1,000 as ordinates, together with the results of other investigations. The curve is practically coincident with that obtained by Davis, in the work already mentioned, who made careful

investigations with pipe of the same size and presumably the same type of surface. It is also virtually coincident with that of Saph and Schoder, who conducted experiments on new seamless drawn brass pipe of the same nominal diameter. The slope of the author's curve, however, is somewhat greater than that of Saph and Schoder and corresponds more nearly to those of Davis and of Hazen & Williams. The latter seems to give a very small factor of safety for water flowing at the usual range of velocity.

Expressed in the form so frequently seen in textbooks on hydraulics, the Davis curve is $H = 2.40\,V^{1.88}$; that of Saph and Schoder is $H = 2.83\,V^{1.75}$; and that of the author is $H = 2.50\,V^{1.80}$, where H = the loss of head in feet per 1,000 and V is the velocity in feet per second.

It is interesting to note that the results of work of so many investigators produce curves whose slopes so nearly coincide. The curves of many other investigators would merely crowd the space on the figure between the curve of Lampé and that of the author. In this connection, it is only fair to bear in mind that the Kutter constants were derived from data obtained from open channel experiments and, that the formulas of Fanning and Flamant were intended for ordinary water pipe. In fact, had it not been for the uncertainty concerning the accuracy of the usual and most popular diagrams and tables, these tests would not have been conducted.

Present Status of New High-Strength Steel

LAST July the German Railway Co. (Deutsche Reichsbahn Gesellschaft) approved a new plain carbon steel of high strength for use in steel structures for the railway. From subsequent deliveries of such steel it appeared, however, that in some cases a low ultimate strength (61,000 lb. per sq.in.) was obtained, while the yield-point was above the specified minimum (43,000) and the elongation was satisfactory (over 18 per cent). Such material was not considered to meet the requirements desired in high-strength steel as safe for use with the 30 per cent stress increase allowed. A change in the acceptance specification was therefore made by the railway company under date of Nov. 10, fixing the ultimate tensile strength at 68,000 to 82,500 lb. per sq.in. (48 to 58 kg./mm²) but requiring the yield-point to be determined for information only and not as an acceptance condition. In the case of current contracts the previous specifications may be continued in force, but whenever a disproportion between yield-point and ultimate strength is found as above cited, the material is to be considered acceptable only in case annealed test specimens show a yield-point as high as unannealed.

In using the high-strength steel, the minimum thickness of metal in bridge work is to be $\frac{5}{16}$ in. (8 mm.), or in I-beams and channels $\frac{1}{4}$ in. (6 mm.), the smallest angle leg $2\frac{3}{4}$ in. (70 mm.), and the least rivet size $\frac{11}{16}$ in. (17 mm.). Wide-flanged I-beams in bridgework are to be limited to 16-in. depth (40 cm.).

In order to distinguish the material from ordinary structural steel, shape steel is to be marked with a longitudinal white paint streak, full length; plates are to be marked at intervals of 5 ft. with white circles containing the designation "St 48," rivet rods are to have the ends marked white, and rivets are to have the letter "H" embossed on the shop head.

Experience with High-Strength Steel—In a discussion of the new steel at the meeting of the Deutsche Eisenbau Verband recently (see "Zeitschr. des Ver. deutscher Ingenieure," Nov. 29, p. 1251) the development of the material and some experiences with it were outlined. The German Industrial Standards Committee has been working toward a reduction in the number of steel grades, and has aimed to define as standard structural grade a material with ultimate strength ranging between 52,500 and 64,000 lb. per sq.in., fixing as special grades three types of minimum ultimate strength 48,500, 60,000, and 62,500. The railway specifications of 1922 demanded a minimum yield-point in standard bridge steel of 34,000 lb. per sq.in., permitting a working stress of 20,000 lb. per sq.in. with this yield-point and higher basic stresses with higher yield-point values. Because of material shortage in recent years, however, the railways took up for consideration a special steel produced by one rolling mill, with 78,500 lb. ultimate and nearly 50,000 lb. yield-point, which had previously been used in naval construction and had also been used in other steel construction with a working stress up to 34,000 lb. per sq.in. Joint study of the matter by the steel producers and the railway officials then led to fixing the specification values for this material for railway structural use as before noted, and allowing unit stresses 30 per cent higher than those fixed for normal structural steel.

It is stated that with this material shop labor costs are 20 per cent higher, and total fabrication costs 7 per cent higher. The saving in total cost of bridges ranges from 7 to 26 per cent for spans from 50 to 200 m.

Professor Memmler, of the Gross-Lichterfelde Testing Laboratory, proposed fixing a maximum yield-point and minimum elongation for the new material. While some suggestions for modification of the specification values were made, including one expression in favor of a steel of 63,000 to 74,000 ultimate with 23 per cent elongation, engineers generally were strongly in favor of the new material, while steelmakers apparently anticipated difficulties in providing for a regular supply of the new material in the beginning.

Hollow Steel Ties Tried in Germany

Experiments with hollow steel ties filled with ballast on the Reichsbahn or State Railways at Dresden, Germany, are reported to show advantages over the trough type of steel tie which is used extensively in that country. The hollow tie is made from a steel plate bent to form a practically oval tube, 10x6½ in., with its top flat for a width of 5 in., sides curved to 2¾ in. radius and bottom inclined 1 on 4 to a narrow opening at the middle. The rolled trough ties are about 9½ in. wide and 3¼ in. deep, with the top flat for 5 in. In the new design the main purpose is to give an elastic or flexible support to take up the wave movement in the rails and thus relieve the strain on the bolted clip fastenings, which ordinarily have to hold the rail to a rigid support. It is stated that during a certain period the bolts of the trough ties required tightening twenty times as against three times for those of the hollow ties. Since only the top and sides of the tie deform in yielding under the rail, there is said to be less crushing of the ballast and consequently less tamping to maintain the track in surface. This hollow steel tie is the invention of R. Schiebe, of Klotsche, near Dresden, Germany.

One of a Series of Articles on the Details of Design and Layout of Different Types of Industrial Buildings

The Modern Fine-Paper Mill: Design and Equipment

Selecting Mill Location—Economics of Building Design and Plant Layout—Importance of Light and Ventilation—Machinery and Processes—Material Handling Equipment

By H. M. Grasselt
Superintendent, Riverside Paper Co. Division, American Writing Paper Co., Holyoke, Mass.

A "FINE-PAPER" mill, in the papermaker's parlance, is a plant engaged in the manufacture of rag-content papers; that is, grades of paper which consist partially or wholly of textile fiber. The material may be divided into old and new, domestic and foreign rags at widely varying prices. In a fine-paper mill manufacturing bond papers, ledger and other high-grade papeteries and similar lines, mostly new domestic rags, such as shirt cuttings, blue overalls, silesias No. 1, etc., and a few better grades of foreign rags are used. A view of the mill of the Riverside Paper Co. division of the American Writing Paper Co., at Holyoke, Mass., is shown in Fig. 1, while the flow of operations in a fine-paper mill is illustrated by Fig. 2. Machinery and equipment used in the manufacture of paper require that the buildings be of unusually substantial construction and conveniently arranged so as to meet the requirements for the respective manufacturing processes which they contain.

Competition in the paper industry is exceedingly keen and the construction of a new plant or modernization of an old mill has to be based on definite economical principles. The manufacturer must be able to compete successfully against similar lines, and this desirable condition is achieved only through maximum production at minimum production cost. Furthermore, location of the plant, arrangement of buildings, and machinery and equipment are decisive factors relative to the prosperity of the enterprise.

The necessity of having available a permanent and large supply of water that is as much as possible free from impurities, chemicals and "soluble iron," plays an important part in choosing the location for the paper mill. While many impurities of the feed water can be effectively removed by the application of filter systems, "soluble iron" cannot be so easily eliminated and its presence is manifested by certain detrimental features, such as injuriously affecting the color of the paper or reaction in processing. For the purpose of economical production, paper mills are, as a rule, situated on the bank of a stream or canal system, so as to be near the source of water power or hydro-electric power. Furthermore, an analysis of raw-material markets as well as markets for the finished products is absolutely necessary.

A fine-paper mill, unlike a plant making newsprint or similar classes of paper that consist of wood fiber, need not be located near extensive timber lands, since sulphite and soda pulps constitute only a certain percentage of the raw materials for "fine papers." The principal centers for rags required in the manufacture of fine papers are places with extensive textile industries, large cities with centralized rag collecting and packing undertakings and, finally, ports of entrance for foreign rags. The proximity of the mill to such centers determines the freight rate and convenient obtaining of supplies and also influences the selling prices.

Buildings and Plant Layout—In laying out plans for a new plant or for the remodeling of an old one, every possible means of increasing production capacity and decreasing production costs has to be taken into consideration. Prerequisite to maximum and economical production are well-constructed buildings and efficient arrangements of machinery and equipment, whereby one phase of manufacture is close to the other to insure continuous operations and movement of the processing product from one operation to the next without much extra handling and intra-factory trucking. The flow of operations must be based on "straight line" principles, since direct routing saves time and excessive costs of manual labor or large investments in material-handling equipment.

In locations where low prices for mill sites prevail, the one-story building will be the most efficient and convenient housing arrangement for the manufacture of fine papers. However, high land values usually compel the erection of multi-story buildings with, perhaps, three floors. Under such conditions only the buildings housing the paper machines are one-story structures on account of heat, exhaust steam, ventilation problems and other physical conditions attendant on the operation of these machines. The structures of the buildings must necessarily meet the requirements for efficient operation and highest production, protect the workmen's health and well-being and eliminate fire hazards. Buildings of structural steel, brick and concrete, gypsum roofed, are best adapted to the manufacture of fine papers.

In a multi-story building, the third and second stories, used respectively as storage and sorting rooms, should have floors consisting of a reinforced-concrete slab with pine sleepers embedded in cinder concrete and carrying maple top flooring. In the beater room, the floor construction should consist of steel beams entirely encased in concrete. It is further essential to design the beater room with roof trusses spanning the entire width of the room, for the purpose of eliminating all posts and columns that may obstruct effective trucking of raw materials. In the paper machine building, reinforced-concrete floors carried by steel beams and H-columns on reinforced-concrete spread footings are required because of the heavy machines. Usually that floor is planned to carry a live-load up to 400 lb. per square foot. The rapid motion of the paper machines also demands special arrangements to offset the vibration, this provision being in the form of girders carrying the sills, made up of H-beams and having a concrete cushion to deaden vibration.

in the finishing room, at the end of the machine room, the floor is similar to that of the storage and sorting floors. There should be a loading platform along the side where the railroad spur track runs the entire width of the building. In the basement below the beater room and machine room buildings are the stuff chests, pumps and equipment for sizing, etc. Spouts lead from the beaters to the stuff chests, from which the pumps deliver to the jordans. From thence the stuff flows into the machine chests and from the latter it is pumped to the screen.

Sanitation and Safety—Sanitation and the comfort of the employee must be kept in mind. Ventilation in the paper machine room is especially essential to the health of the workman as well as to the condition of the paper. The number and the size of the ventilators that pass through the roof are determined by the size and number of driers on the paper machine. Light and comfortable rest rooms with communicating lavatories must be provided and all buildings must be properly protected by a system of water mains, hydrants and sprinkler equipment. Safety devices are to be provided in accordance with regulations, requirements and recommendations. Elevators, main shafts, transmissions and gears have to be effectively guarded; platforms, elevated runways and stairs must be in good condition and kept clear of obstructions.

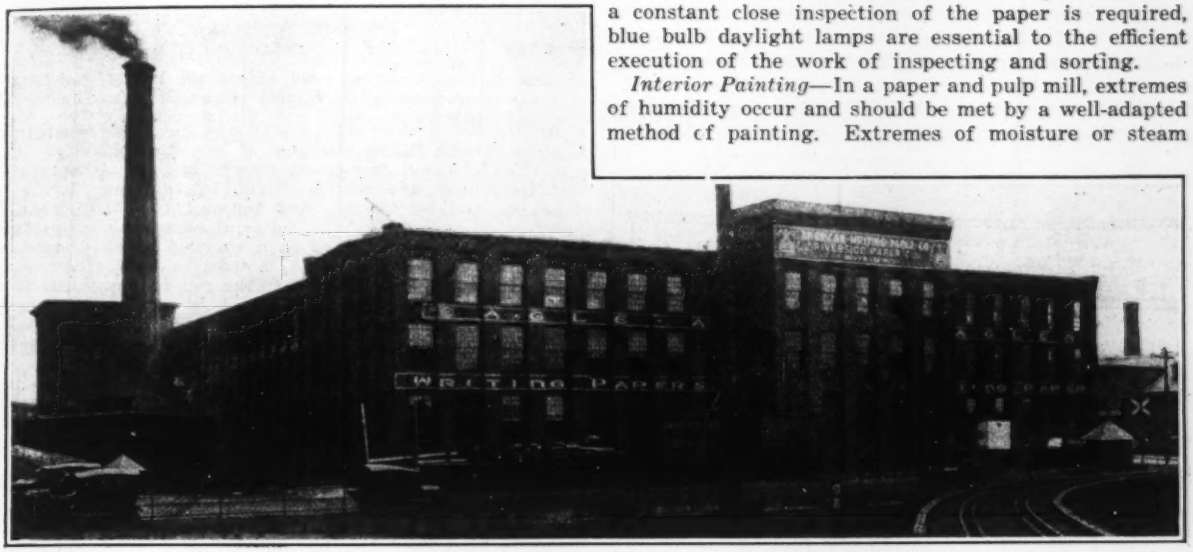


FIG. 1—TYPICAL MILL FOR FINE-PAPER PRODUCTION

Lighting—Efficient operation in every department requires the maximum of daylight and careful consideration for safe working conditions. Since work in a paper mill generally lasts 144 continuous hours a week, special attention must be given to artificial lighting. During the past few years, thorough analysis and study of that problem have resulted in marked progress toward better lighted mills and a corresponding decrease in accidents. There is now less waste and higher production than heretofore, and a noticeable improvement in individual efficiency. Posts, pillars and machinery will cast shadows if the arrangement of light is defective and inadequate. It would be detrimental to the work of the mill to try to economize on lighting. A good lighting arrangement aids production qualitatively and quantitatively, and is a big factor in safety work.

Distribution of artificial light must be adequate and according to special requirement in the separate departments. For instance in the rag room, light over the sorting tables must be clear, but not glaring. There should be sufficient lights over each sorting table, their number depending on the size of the tables. In the beater room, 100-watt lamps on dome reflectors with about 12-ft. hang and spaced correctly on centers, have proved to be very practical and of direct bearing on the speed of work performed in that room. The paper machine room is to be provided with low hanging lights in sufficient numbers, while in the finishing room, where a constant close inspection of the paper is required, blue bulb daylight lamps are essential to the efficient execution of the work of inspecting and sorting.

Interior Painting—In a paper and pulp mill, extremes of humidity occur and should be met by a well-adapted method of painting. Extremes of moisture or steam cause metal surfaces to rust and corrode and a coat of paint will, therefore, prevent the process of deterioration. A standard color for each surface, especially designed to serve its individual purpose most effectively, should be introduced as a means of protection. Only the best and most durable paint is to be used. Standardized painting, with carefully selected and adapted colors, makes for better preservation of materials, piping and fixtures and also renders the appearance of the interior of a plant more attractive. Preservation of equipment from rust brings lower maintenance costs.

Electrical Power—Power and heat are important items in the cost of production and the problem of reducing these cost items to a minimum has, therefore, received the intensive attention of engineers, architects and manufacturers. Although the application of electrical power is only in its initial stage, recent statistics show that the electrification of the pulp and paper industry is progressing rapidly. Today the primary electric power used in the industries mentioned represents one-third of their total horsepower.

In a paper mill there are heavy requirements for steam for processing, but new installations of electrical power equipment are reducing gradually the use of steam as a prime power, while old mechanical drives are fast giving way to the more efficient electrical drives.

Built-in motors in modern paper machines are replacing the belted drive. The sectional paper machine drive, now extensively used, is steadily improved upon and tends to lower costs and the elimination of certain machine parts. Individual motor drives permit the maintenance of speed at desired values and its adjustment over wide ranges, the speed control being regulated by means of push-button stations. Individual motors save power, since there are no transmissions that carry dead loads. Electrical power is easily generated and may be transmitted over considerable distances.

Material-Handling Equipment—Mechanical methods of handling and conveying material occupy an important place in the pulp and paper industry. High cost and scarcity of unskilled labor have given the introduction of material-handling equipment an exceptionally great impetus; mechanical carriers have in many instances replaced manual labor and have reduced the costs of intra-factory transportation to a minimum. A system of conveying, properly applied, will link up every process into a perpetually functioning unit and prevent waste of time.

Although the layout of a plant should be such that

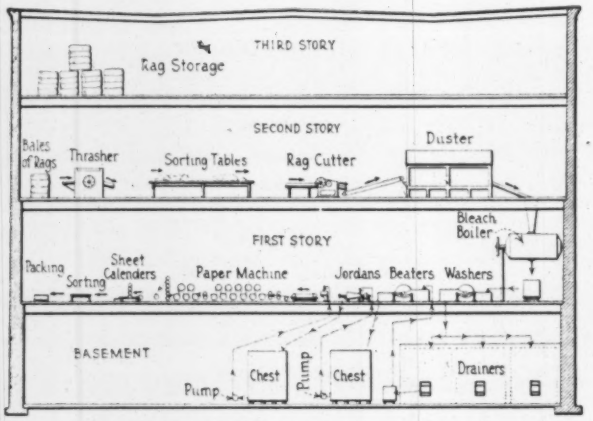


FIG. 2—PLANT ARRANGEMENT IN FINE-PAPER MILL

as little conveying equipment as possible is required, no mill can be entirely without elevators or other conveying equipment. Such equipment must be adapted to the individual needs of a plant and must meet special requirements. It may be divided into the following classes: Hoisting machinery (cranes, hoists, derricks, winches, loaders and unloaders), package handling conveyors and elevators, belt conveyors, hand trucks, storage battery and gasoline trucks and tractors.

The Committee on Waste in the Pulp and Paper Industry has gathered very complete data about mechanical handling of materials in the paper industry and stated as follows in a progress report, published in *Paper Industry* in November, 1923:

Every handling problem is a special study in itself, although in general mechanical equipment should be considered whenever the following conditions are evident: (1) Continuous stream of materials to be moved more than 50 ft.; (2) continuous lifting of loads; (3) elevation of quantities of materials; (4) lowering of quantities of materials; (5) whenever materials require half-hour or more of manual labor for moving intermittently; (6) continuous movement of materials for a distance of more than 6 ft.; (7) continuous assembling work.

Storage Facilities—Adequate storage facilities and the location and temperature of storerooms are to be taken into consideration in order to avoid spoilage and deterioration of materials. Pulp and rags are to be stored in places where they do not rot or mold. Coal is to be stored as close as possible to the place of consumption, that is, the boiler house. Storerooms must be spacious and permit of economical and rapid handling of materials and finished products.

Environmental Control in Public Health Program

A Broader Conception of Environment and an Extension of Sanitary Effort Are Needed to Add to Gains Already Made

BY ABEL WOLMAN
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Abstract of a paper read before the annual meeting of the American Public Health Association.

PROGRESS in the public health movement has much in common with the development of any other activity. It is marked by rapid changes of concept in some periods, by slow methodical advance in others, by changing flaming standards and by fetiches and taboos. It is important, therefore, to stop in one's activities at reasonable intervals long enough to take stock of such varying methods, standards and concepts as are in use, in order to evaluate specific forms of work in their relation to the general program. It is my understanding that my task is to perform such an analysis with reference to the part which the control of environment plays or should play in the public health programs of today and tomorrow.

In any historical review of a subject or a movement, it is frequently convenient and sometimes valuable to divide the progress thereof into chronological eras. In so doing in our own field, the "era of environmental sanitation" is commonly assigned to the latter half of the nineteenth century. We are now living in the "era of personal hygiene." Between the two we rode blithely through the "era of infectious disease work." There appears to the writer to be a serious fallacy underlying attempts to subdivide progress into eras, where such subdivisions are used as the keys to future methods of activity and education. The fallacy lies in the assumption that the recognition of the causes of a particular disease is equivalent to the elimination of the effects of that disease. It is often stated, for example, that, in the period of environmental sanitation, we recognized the causes and modes of transmission of such diseases as typhoid fever, malaria, yellow fever, cholera, etc., and, therefore, the emphasis upon these diseases need no longer be stressed. The recognition and the more complete scientific demonstration of the effects of environment upon health, however, antedating as they do, perhaps, the same recognition and demonstration of the importance of personal hygiene upon health, should be preserved as auxiliaries to the added knowledge of more recent eras.

Sanitation—Barring the comfortable plan of assigning all accomplishments in health improvement to improved human stock and all future victories to further favorable hereditary influences, it is usually admitted that the major non-debatable fruits of conscious effort in past decades are those resident in sanitation—the provision of safe water supplies, the adequate disposal of sewage, the eradication of mosquitoes, the control of milk and other food supplies and similar so-called elementary undertakings. It is not usually a matter of controversy that some of the major achievements of the past in public health progress through the control of typhoid fever, dysentery, cholera, yellow fever, typhus fever and plague (in so far as this last disease has been controlled) have been primarily through the attacks upon the environment of man. These past accomplishments have many future implications.

Although the typhoid fever death rate had reached in 1920 a figure of less than 8 per 100,000 in the registration area of the United States, there are still literally hundreds of communities in this country and elsewhere which are

confronted with excessive typhoid fever death rates. When we compare our own figures in the registration area with those in some foreign countries, we have little reason for complacent abandonment of communal sanitation. In addition, to retain even what has been gained in the case of typhoid fever is becoming increasingly difficult when the enormously increasing pollution of our streams by human wastes is considered. Few health officers appear to realize the enormous problems confronting the American public in the situations arising in such streams as the Ohio and Illinois Rivers, where the number of persons involved in sewage pollution and the areas under consideration are not matched by any other stream in the world. The growth of population in this country has been rapid in past decades. We are now in the period of necessary increasing dependence upon more highly polluted streams for drinking water. The increasing use of large rivers and lakes as sources of municipal drinking water is superimposing new problems of water and sewage treatment upon the older and more familiar difficulties. Most of us engaged in this work are well aware of the necessities confronting us of developing more complete methods of water and sewage treatment than any now available. The subjecting of waters to double treatments and the ever-increasing refinement of sewage purification are direct resultants of dwindling safe water resources for human consumption.

Even assuming that, in such environmental diseases as typhoid fever, we have reached in some areas some degree of successful control, we must not neglect the obvious fact that many communities, aggregating millions, are still without the most elementary requirements of safe drinking water and of adequate disposal of human excreta. It is doubtful whether there are any states in the Union in which even three-quarters of the population is beyond the necessity of improved water and sewerage equipment which would meet even moderately desirable standards. Aside from these new installations, it is well to emphasize most strongly the obvious importance of maintaining the present degree of control, where it has reached a successful point. The maintenance of an environmental advantage in public health can certainly not be secondary to the original establishment of this control. Typhoid fever, plague and cholera still take their thousands in toll. Knowledge as to their control is at hand, but their elimination is still a fruitful part of the health worker's day.

Malaria—Probably one of the most remarkable demonstrations in public health accomplishment in this country is the malaria prevention work in the southern and southwestern states. No single disease causes more discomfort or more economic loss than malaria. The primary attack upon it has been through measures directed at changes in environment. Although the disease itself is ages old, the developing technology of its control in different areas is one of the most interesting and novel of demonstrations available today in preventive medicine methodology. The relative adjustments of large-scale drainage projects, oiling measures, fish culture, house screening, domestic animal screens, larvicides, and quinine prophylaxis measures to meet the manifold exigencies of a thousand and one areas are both amazing in their complexity and fruitfulness for further study and satisfying in their past performance and future promise. The incidence of malaria covers the globe, with millions in India, in the Ukraine, in Russia, in Italy, in Greece, in Palestine, in South America. It is interesting to reflect upon the importance of malaria control when for over 25 years in Russia alone not less than 3,000,000 cases have been noted each year with almost 5,000,000 in the first nine months of 1923. Although quinine prophylaxis has been available for many years, as a means of attack upon malaria, mosquito control through community measures survives as a major procedure. The prevention of malaria today remains a branch of environmental sanitation and of public administration. Certainly in this field the future holds no darkness for engineer, biologist, or statistician.

Tuberculosis and Housing—In adolescence and early maturity, tuberculosis in its various forms is the outstanding wielder of the scythe of misery. The tremendous influence of social and physical environment on the maintenance and development of this endemic disease has been pointed out for decades. The lack of fresh air and sunlight and overcrowding and the attendant spreading of mass infection are certainly factors to be reckoned with in the control of the disease.

More recently, in the Year Book for 1922 and 1923 of the Association of Tuberculosis Clinics of Greater New York, Inc., the influence of better housing conditions in raising resistance to tuberculosis is strikingly brought out by comparative statistics for similar populations, independent of race and color. For example, the Jews, with well-established resistance, show in the same year a death rate from tuberculosis, in the group living in the old tenements of the lower side of Manhattan in New York, of 70 per 100,000, in the central Tremont district of the Bronx, with better housing, of 59, and in the Brownsville District of Brooklyn, an area of spaciousness and individual homes, of only 39 per 100,000, "a rate as low as that of Framingham, the seat of the well-known tuberculosis control demonstration in Massachusetts of the National Tuberculosis Association."

Even the Italian and colored populations show the advantages of the modern planning and housing in the Corona district of Queens Borough, with a rate of 69, and in the district around Jamaica, noted for its individual home development, with a rate of 64. Here we have large-scale demonstrations of a situation normally not available for proof. It is reasonable to suppose that at least one factor in the spread of tuberculosis may be associated with environment, although we must be particularly cautious in correlating two such intricately connected social events as housing and health.

Although the control of the respiratory diseases has not advanced sufficiently far to warrant claims of any kind, there is still some evidence, much of it debatable and requiring more careful confirmation, that housing, ventilation and adequate provision of fresh air may be salutary aids in reducing mortality.

Industrial Hazards—During man's productive life, he is confronted with hundreds of industrial hazards, whether at work in the mine, in the steel mill, in the shop, in the office or in the open air. All of these hazards, whether specific in the process or remotely associated with the occupation, have environmental implications. The elimination of the hazards of mining, of potteries, of the printing press, of Bessemer furnaces, of glass work, of dyestuffs and chemical manufacture, of caisson and tunnel work, all require joint effort by engineer, chemist, physicist and physiologist.

Industry obviously is primarily the working ground of the engineer. Upon him rests the development of process, the introduction of new equipment, the elimination of the hazards of the old methods, machinery and materials. Although the medical officer has frequently ignored the importance of this amazing environmental field of public health effort, unfortunately the engineer all too frequently also has avoided trespassing therein. The improvement of working conditions in industry, by developing standards through research and by introducing resultant improvements in lighting, ventilation and sanitation, must be in major part of the province of the engineer. When we consider the study of elimination of the "process hazards," such as dusts, poisons, infections, heat and humidity, excessive cold, compressed air work, noise and vibration, the engineer's contribution in the team play of physiologist, chemist and physician is much greater than the engineer himself has sensed. The problems are new, complex and important. They await attack.

Broader Conception of Environment—In all that has so far been said, the importance of environmental control for the present and the future has rested upon a narrow definition of environmental activity. I should like, for a moment, to expand upon the possibilities of the future by envisaging a physical environment delicately adjusted to the optimum physiological requirements of the individual. Heretofore, we have emphasized the control of the negative side of environment by attempting to eliminate and prevent those "accidents" of this mundane sphere to which man has been exposed, as typhoid fever, malaria, yellow fever, industrial accidents, acute infections, etc. Little or nothing has so far been contributed to the positive phase of environmental control, that is, the maintenance of a higher level of physiological efficiency at all times by the proper adjustment of the factors in environment. Obviously, our knowledge of the underlying principles of the positive effects of

such adjustments of housing, ventilation and heating, upon man are exceedingly meager, but no one will question that the individual's adaptation to this world may be improved by changing the individual or by modifying his physical environment. How far this latter form of control may be extended we do not predict, but its limitations at present are in the almost complete absence of positive adjustment of environment and in the very fragmentary knowledge of the relation which the controllable physical world actually bears to physiological function. Both of these limitations time must necessarily remove, for they are limitations of inertia and ignorance.

In closing, I may be pardoned a parting word to my confreres in the field of environmental sanitation. Much emphasis has been given in the preceding discussion to the failure of some workers to recognize the present and future possibilities of environmental control in public health work. It cannot but appear, after study of this situation, that this same failure to take advantage of the fruitful opportunities before us has been the striking characteristic in many instances of both pedagogic and practicing engineer. Engineering in public health has connoted water supply, sewage and refuse collection and treatment in most of its history. Engineering pedagogy has followed orthodox practice by devoting most of its energies to the elucidation of the principles of these restricted fields.

The intent of this paper is not only to indicate a fruitful continued field for environmental control in the public health program, but to point out to the engineer the wonderful prospect for the application of intelligent research, careful practice and interesting accomplishment awaiting him in the fields of malaria control, housing design, city planning, industrial hygiene and sanitation, food handling, etc., in the adjustment of the environment to the maximum advantage of the individual. Perhaps the mistaken coma in environmental control has had its origin in the unconscious state of that foremost exponent of environmental regulation of past decades, the sanitary engineer himself.

Highest Earth Dam in Scotland

What is described by the London *Engineer* as the highest "reservoir embankment" in Scotland "and one of the highest in the United Kingdom" was completed late in 1924 for water supply of Dunfermline and other boroughs. The dam is 108 ft. high above the river bed, has inner slopes of 1 in 4 below and 1 in 3 above, an outer slope of 1 in 2½ overall, with two 15-ft. berms. The reservoir storage capacity is 1.2 billion U. S. gallons.

Mountain Pass Highway Bridge Built on Sharp Curve

Concrete Viaduct at Foot of Steep Grades Has Radius of 175 Ft.—Roadway Superelevated 24 Inches

BY HARLAN D. MILLER

Bridge Engineer, California Highway Commission, Sacramento

THE CALIFORNIA Highway Commission has just completed the construction of a bridge unique in being built on a grade on a very sharp curve over a deep ravine. The bridge is of the reinforced-concrete trestle type, being composed of alternate girder spans and towers. It is located on a pass through the mountains known as the Pacheco Pass, some 21 miles east of the city of Gilroy.

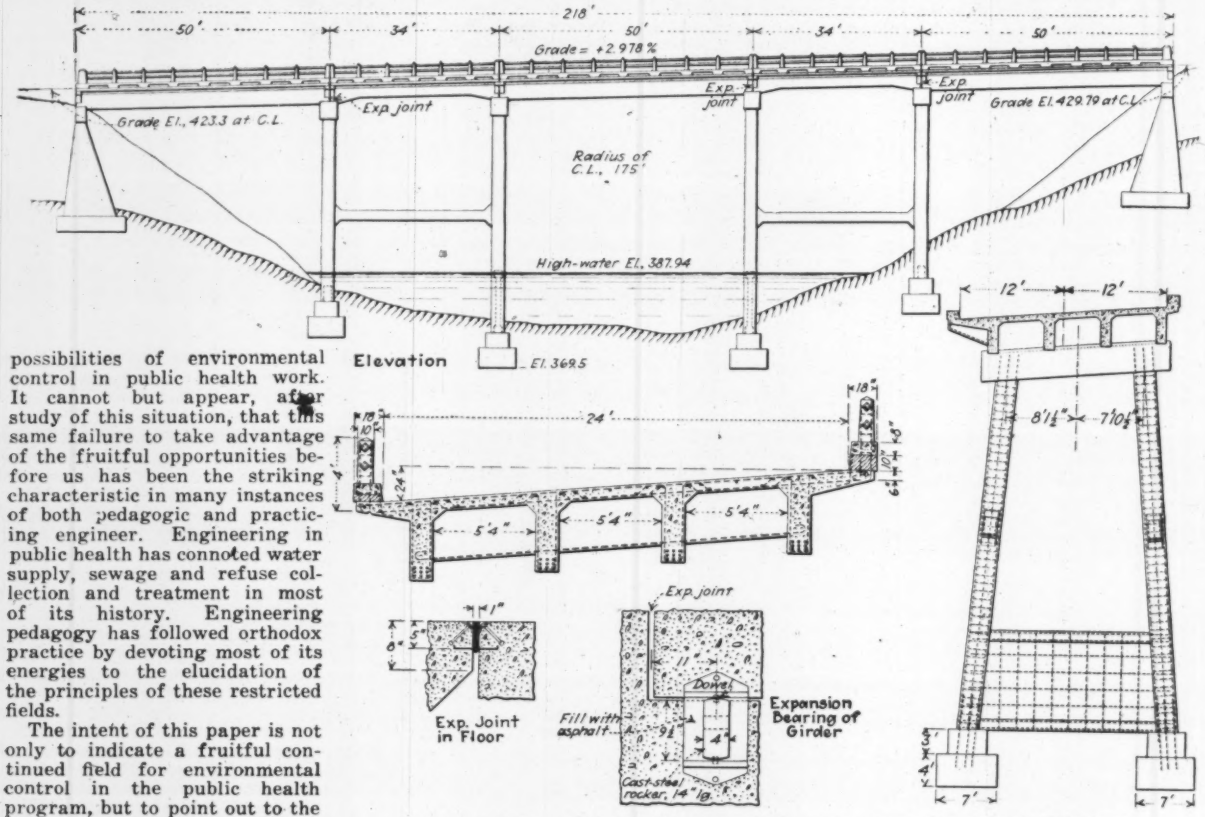

FIG. 1—SOME CONSTRUCTION DETAILS OF PACHECO CREEK BRIDGE

The new state highway approaches this bridge at both ends down long steep winding grades. The bridge is on a sharp curve at the foot of these grades. It is 218 ft. long, has a 24-ft. roadway width between curbs, is built on a radius of 175 ft. and has a 3 per cent grade over it. On account of the sharp curve over the bridge the outside of the roadway was superelevated 24 in.

The bridge is composed of alternate 50-ft. girder spans and 34-ft. tower spans. The 24-ft. width of roadway is carried on four girders, these girders being supported on heavy cross-girders at the top of the two-column bents of the towers. The cross-girders of the

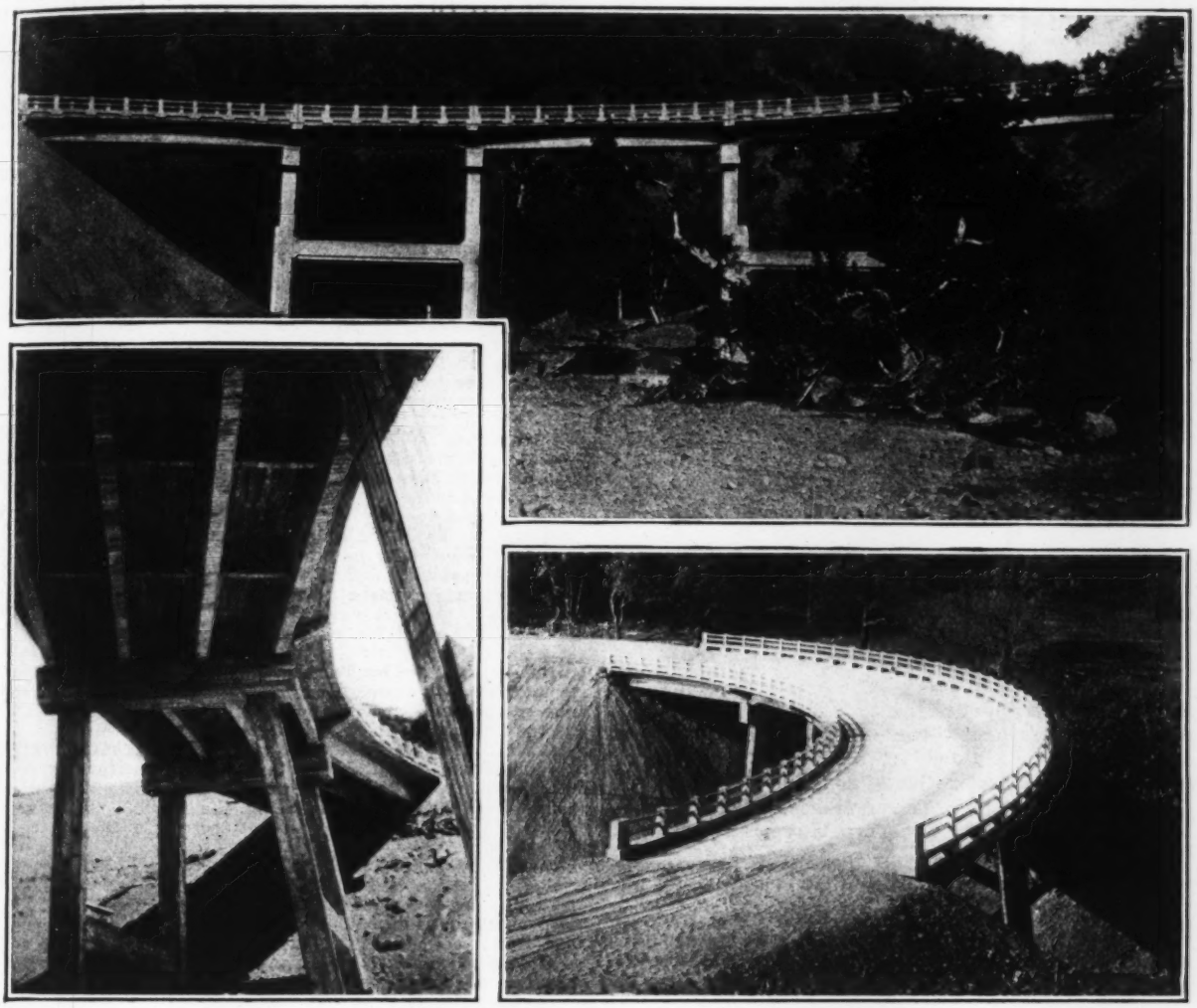

FIG. 2—PACHECO CREEK BRIDGE, NEAR GILROY, CALIF., BUILT ON CURVE OF 175 FT. RADIUS

towers were made exceptionally wide and heavy in order to support the expansion details at the ends of the 50-ft. spans. Expansion joints were placed under the ends of the 50-ft. spans only. These expansion joints were made up of cast-steel rockers, the rockers being embedded in recesses in the supporting girders.

At the highest point the floor of the bridge was some 46 ft. above the creek bed and the longest columns were about 34 ft. in height from their base to their cap. The columns were battered 1 in 12 crossways of the bridge and were made 30 in. square.

The wide easy approaches to the bridge emphasize its gracefulness and the exceptionally large superelevation of 24 in. in the roadway width is a most attractive feature to the motorist since it permits him to come down the approach grades at a good speed and cross the bridge in perfect ease.

The bridge was designed for a live-load of two 15-ton trucks with a uniform load varying from 70 to 130 lb. per square foot. The unit stresses allowed were 650 lb. in the concrete and 16,000 lb. in the steel.

The bridge was built by John Simpson Co. of Los Angeles and cost about $28,000. There were 675 cu.yd. of 1:2:4 concrete in the structure. The contract price for the concrete was $26.60 per cu.yd., without the steel, which was paid for at 7c. per pound in place.

Algiers Begins Big Port Project

The port of Algiers, which has remained pretty much what it was when the French took possession of it from Hussein Dey nearly a century ago, is being rebuilt. The present project, now under way, in the hands of the Etablissements Schneider et Cie, the Société Hersent and the Etablissements Daydé of France, includes work which will not be finished until 1938, and which will cost around 153,600,000 francs. The Chamber of Commerce of Algiers has submitted the plan for the approval of the government as the complement of the work which has been already undertaken. The Mustapha basin will have a mole 700 m. in length with open storage space of 28,000 sq.m., with a further 19,800-sq.m. of made ground which may be added as required. Another mole will have a length of 400 m. with an open storage area of 34,500 sq.m. The opening or pass between the moles will have a width of from 20 to 30 m.

Special Contract Devised For Narrows Tunnel

Contingency Contract Based on Installment Construction of Two-Mile Tunnel Under New York Harbor

A CONTINGENCY contract, which also has the purpose of determining comparative prices on two methods of construction, has been drafted for the long-planned tunnel under New York Harbor between Brooklyn and Staten Island. This tunnel is known as the Narrows Tunnel, is a twin-tube tunnel and the section being considered—New York Harbor Section—is 10,400 ft. long. It is designed for both freight and passenger service. The two methods of construction to be bid on are the regulation shield method and the trench method by which fabricated sections of tunnel are sunk end to end in a dredged trench and the ends are connected under water by shield or other operations. Complete plans have been prepared for structures of both types.

As indicated, the purpose of the tunnel contract proposed is to secure comparative prices on two methods of construction and also "to relieve the city from a large encumbrance to the debt limit for funds for construction costs which would not have to be met for some time in the future." The terms as stated by Arthur S. Tuttle, chief engineer, Board of Estimate and Apportionment, under whose authority the work stands, are given below. On Jan. 19, 1925, the Board authorized the initial appropriation of $6,500,000 and directed that advertisement be made for proposals for construction. The excerpt from Mr. Tuttle's report follows:

This new form of contract is, essentially, four similar contracts, one for each of the four parts comprising the New York Bay Section.

Under the shield method, Part 1 includes the partial construction of 1,763 ft. of tunnel, divided between the two sides of the Narrows; Part 2 includes the partial construction of an additional length of 3,912 ft. of tunnel, divided between both sides of the Narrows; Part 3 includes the partial construction of an additional length of 3,635 ft. of tunnel near the middle of the Narrows; and Part 4 includes the completion of the construction of the tunnel throughout between the easterly side of the Shore Road shaft and the westerly side of the Richmond shaft. Under the trench method, Part 1 includes the partial construction of 1,083 ft. of shield and rock tunnel divided between both sides of the Narrows and the sinking of one trench tunnel section, about 266 ft. long, on the Brooklyn side; Part 2 includes the driving of an additional length of the shield and rock tunnel on the Richmond side of the Narrows and the sinking of nine sections of the trench tunnel shell; Part 3 includes the sinking of nine additional sections of the trench tunnel shell; and Part 4 includes the completion of the tunnel throughout between the easterly side of the Shore Road shaft and the westerly side of the Richmond shaft.

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A deposit of $75,000 is required with the bids. The amount of the bond to be provided for each part under the shield method is $1,500,000, while under the trench method $1,500,000 is required for Parts 1 and 4 and $2,500,000 for Parts 2 and 3. The retained percentage is limited to $400,000 on Part 1 and $350,000 additional on Part 2 under the shield method. Under the trench method it is limited to $400,000 on Part 1, with an additional $400,000 on Part 2, and $200,000 on Part 3.

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Coating of Coagulant and Clay Checked Pitting In First Standpipe and Largely Prevented It In One Built at Later Date

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Water for this system is taken from the Missouri River. Between the years 1903 and 1909, no coagulant was used. Between 1909 and 1912, lime was used intermittently. Since 1912, lime and iron sulphate have been used constantly as a coagulant to assist in sedimentation. The turbidity of the raw water varies from 10 p.p.m., when the river is frozen over for its whole length, to over 18,000 p.p.m. during freshets. Average turbidity would be roughly 6,000 to 8,000 p.p.m.

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Examination disclosed a heavy coat of ordinary rust covering the upper 6 ft. of the tank, while the cover over the tower, which was built of No. 10 gage sheet steel, had been completely destroyed by the rust. Below this, for approximately 15 ft., the metal presented a pock-marked surface, about one-sixth of the surface being covered with shallow holes running from ½ to 1½ in. in diameter and having a uniform depth of about 1⅛ in. In no place was the metal rotten at the bottom of these holes, nor was the strength of the plate dangerously affected. The entire inside surface of this section was covered with a very thin hard eggshell coating of some lime composition.

The next 30 ft. of tank, or down to the water level at that time, presented the same pitted surface but each hole was filled with a scaly deposit, probably a collapsed tubercle similar to those commonly found in iron water pipe. When the deposits were scraped away the holes were found to range from ½ to 2 in. in diameter and covered about a fourth of the surface. In all instances noted the metal beneath the deposit was perfectly sound.

The rivets were attacked more than the plate, in instances being eaten down a full ¼ in. All of the rivets used in securing a down spout to the side of the tank in 1916 were free from all signs of corrosion after being subject to the action of the water for over eight years. These rivets, as was the remainder of the tank surface, were covered with the eggshell coating mentioned above.

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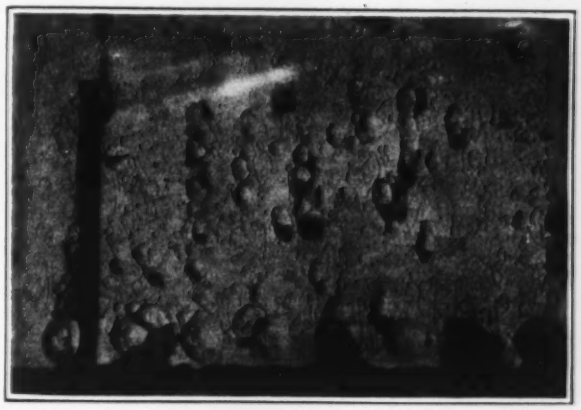

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Special Contract Devised For Narrows Tunnel

Contingency Contract Based on Installment Construction of Two-Mile Tunnel Under New York Harbor

A CONTINGENCY contract, which also has the purpose of determining comparative prices on two methods of construction, has been drafted for the long-planned tunnel under New York Harbor between Brooklyn and Staten Island. This tunnel is known as the Narrows Tunnel, is a twin-tube tunnel and the section being considered—New York Harbor Section—is 10,400 ft. long. It is designed for both freight and passenger service. The two methods of construction to be bid on are the regulation shield method and the trench method by which fabricated sections of tunnel are sunk end to end in a dredged trench and the ends are connected under water by shield or other operations. Complete plans have been prepared for structures of both types.

As indicated, the purpose of the tunnel contract proposed is to secure comparative prices on two methods of construction and also "to relieve the city from a large encumbrance to the debt limit for funds for construction costs which would not have to be met for some time in the future." The terms as stated by Arthur S. Tuttle, chief engineer, Board of Estimate and Apportionment, under whose authority the work stands, are given below. On Jan. 19, 1925, the Board authorized the initial appropriation of $6,500,000 and directed that advertisement be made for proposals for construction. The excerpt from Mr. Tuttle's report follows:

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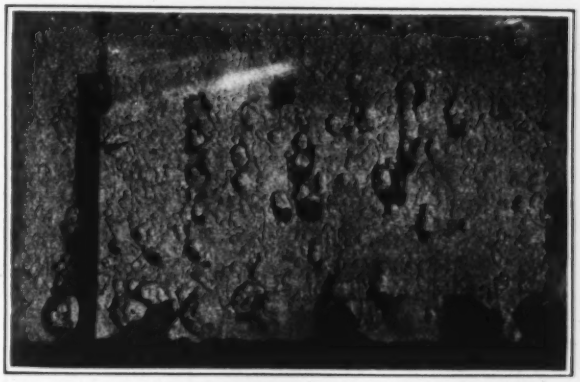

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Wood Preservation Developments and Investigations

Reports at Wood Preservers Convention—Economics of Treatment—Fence Posts, Ties, Mine Timbers—Zinc-Oil Process

PROMISING developments in materials and methods for preservative treatment of timber were included in the several papers and reports presented at the recent annual meeting of the American Wood-Preservers' Association, at Chicago, and some notes of the various studies and tests are given below:

Wood-Tar Creosote—There has been an attempt within recent years to put this material on the market in competition with creosote oil, and the committee on Preservatives reports that the annual production of hardwood tar in this country is about 20,000,000 gal., from which could be produced 7,000,000 to 10,000,000 gal. of distilled oil, the toxic value of which is greater than that of creosote oil. Wood tar can be produced with a viscosity low enough to insure satisfactory penetration, but as it is not yet a standardized material its composition will vary as obtained from different sources.

Zinc-Oil Emulsion Treatment—A new process in which treatment of timber with zinc and oil is accomplished in one movement or operation, instead of two separate operations, as heretofore, has been developed by A. M. Howald, of the Mellon Institute of Industrial Research. This process consists in making an emulsion of the oil and the zinc solution; its special feature is making a satisfactory emulsion by means of emulsifying pumps. Tests carried out at the Somerville works of the Santa Fé Ry. show that impregnation can be effected satisfactorily by ordinary equipment, but the usual temperature of 180 deg. F. must not be greatly exceeded. Assuming that the timber thus treated will be protected against mechanical wear, it is said to be evident that this new process promises economies in cost of treatment. One feature is that to facilitate control of the zinc-chloride concentration, it is desirable to have only a small reserve of the emulsion; but a large reserve is not necessary because the emulsifying pumps may be of sufficient capacity to replenish the supply during each charge of the treating cylinder.

Viscosity and Penetration of Oil—On the basis of research undertaken by J. D. MacLean, U. S. Forest Products Laboratory, the committee on Preservatives states that it is probable a relation will be established between the viscosity of oils and their penetration into wood.

Steam and Vacuum Treatments—Supplementing the 1924 report on the effects of variations in steam pressure and vacuum, a progress report by R. M. Wirka, U. S. Forest Products Laboratory, indicates that if only temperatures and reduction in moisture are considered, then the short steam and long vacuum periods are as satisfactory as the long steaming period followed by a 1-hr. vacuum; the short steaming also appears less likely to harm the wood. With steam and vacuum periods held constant, steam pressures of 20, 30 and 40 lb. showed no great differences in the rate of internal temperature of the wood; thus the low pressure is about as desirable as the high pressure for a steaming period of eight hours or less. Contrary to the 1924 tests, the recent experiments do not show that the internal temperature after vacuum varied inversely as the steam pressure.

Tie Treatment and Rot—Many ties from certain regions are found to show incipient heart rot, and there is a question as to the effect of treatment on such ties. Tests made by W. H. Long, U. S. Department of Agriculture, at Albuquerque, N. M., indicate that the treating process of the Santa Fé Ry. sterilized all rot in high-altitude fir and pine, and in most of the Texas pine ties, but for western yellow pine the usual treatments must be modified to secure sterilization. In semi-treated rot, the preservative did not kill all the fungi and there is doubt as to the protective value in sound ties where the hardwood is only semi-treated.

Toxic Principles of Preservatives—Investigations carried out by E. Bateman and C. Henningsen at the U. S. Forest Products Laboratory lead to the following conclusions:

A. Creosote Oils: The essential toxic materials in coal-tar creosote may be divided into two groups: the hydrocarbon oils boiling below 270 deg. C. and the tar acids and tar bases boiling above 270 deg. C. The former may be considered the essential toxic materials of ordinary creosote oil. The high-boiling tar acids and tar bases may be considered the essential toxic materials for high-boiling distillates, such as carbolineums. In this case the hydrocarbons, although potentially very toxic, are rendered ineffective by their low solubility, leaving the work to the less toxic but more soluble constituents.

B. Petroleum Oils: No petroleum oils thus far examined can be used alone as wood preservatives where fungus attack is severe, and it does not seem likely that any American oils can be used alone. Petroleum oils may be used as carriers for one or more toxic materials. These conditions apply only to the petroleums as toxic agents and do not apply to water-shedding properties or any other mechanical advantages they may possess.

Treatment of Fence Posts—The committee on Treated Posts points out that creosote was first applied with a brush, but as this did not penetrate the deeper cracks and checks the dipping process gave better results. Posts dipped for 15 minutes in hot creosote at 212 to 230 deg. F. would check after treatment, exposing untreated wood. For deeper penetration this process was changed to four hours in hot creosote and then two hours in cold creosote of not over 110 deg. F., but there was great irregularity in depth of penetration. The latest development in open-tank treatment is the perforation or incision of the timber to insure complete penetration to the depth required. All open-tank methods are dependent upon the action of capillary attraction produced in the wood cells. The most effective and economical treatment for posts is the pressure method, which insures a deeper and maximum penetration. Non-durable woods thus treated indicate a life far exceeding that of the decay-resisting woods.

Economy of Treated Timber—A method of calculating the relative cost of treated and untreated timber, presented by J. D. MacLean, U. S. Forest Products Laboratory, is based on first cost, length of service, cost of renewal, interest rate, maintenance cost and salvage or scrap value. For example, if a set of mine timbers costing $10 lasts two years, while interest is 6 per

cent and treatment will increase the life to six years, it is shown that 168.2 per cent of the original cost can be spent economically for treatment. Thus, treated timber costing $26.82 would give the same annual charge or capitalized cost as the untreated timber at $10. If the treatment costs less than $16.82 the economy would be still greater. If the treated set cost $16, a life of 3½ years would give the same annual charge as the untreated set lasting two years, while with the assumed life of six years for the former there would be a saving of 40 per cent. With a tie costing $2 and lasting 15 years treated, or $1.40 and 7 years untreated, the former would give the same annual charges with a life of 11 years.

Reduced Amount of Preservative—The committee on Ties recommends that further study be given to the possibility of reducing the amount of standard preservative when treating with mixtures of creosote and petroleum, as a considerable quantity of material treated with relatively small amounts of creosote per cubic foot is giving very promising results.

Boulder Canyon Storage and Power Favored by Dr. Mead

Testimony Before Senate Committee in Support of Swing-Johnson Bill—Irrigation and Power Should Be Joined

PRESENT views of the Bureau of Reclamation are shown to be strongly favorable to the Boulder Canyon project by testimony given before the Senate Committee on irrigation and reclamation by Dr. Elwood Mead, commissioner of the bureau. He declared in effect that only the provision of large storage would take care of the serious water shortage that has developed at the lower end of the river, crop losses of many millions having resulted in Imperial Valley last year and the region having been in imminent danger of failure of water for stock and domestic use.

Power development should be joined with the storage project, Dr. Mead stated. The entire use of the water should be controlled by a single authority, the government. However, the government should not distribute and retail the power but should sell it at the dam to purchasers who would distribute and retail it. Extracts from the testimony follow:

Irrigation Needs — The low-water flow of the Colorado is not adequate for irrigation of the area already under cultivation. The Imperial canal passes through Mexican territory. That is the cheapest route for a canal, and that is the reason the people who first undertook the development of the valley chose it. They could not afford anything more. In order to obtain the approval of Mexico for this canal a contract was made by which it was agreed that one-half of the water diverted should be supplied on demand to irrigators in Mexico. For a number of years that was not a serious objection, because there was very little use of water in Mexico, but in recent years such use has gained rapidly. This increased drain on the water supply has been made more serious by the extension of irrigation in the Imperial Valley, now the largest single irrigated area in the United States.

Shortage of water was quite acute last year, and if we had had the development that we have now it would have been acute in a number of years. Last year the Imperial Valley needed all the water at the low-water season, but had to give up half of it, and the result was a very serious loss to the valley.

The Americans who operate this canal have had to do so under very difficult circumstances. They have to operate in a foreign country, and there are customs regulations and other regulations that hamper them and render it expensive. So I have long held the belief that we need first of all a reservoir large enough to hold water to meet all the demands of the existing irrigated area at the low-water period, and, in addition, to meet the demands of about 250,000 acres of other land in the Imperial and the Coachella Valleys which has not yet been brought under irrigation.

Storage at Boulder Canyon — No scheme that provides only for regulation will meet the situation. The fundamental need is a reservoir large enough to meet the demands of the low-water period. That demand is imperative. Anyone who knows how dry and how hot it is in that country knows that a week without water means the loss of a crop, after it gets to the point where it needs irrigation.

In the opinion of those who have conducted the investigations, Boulder Canyon is the lowest point on the Colorado where a site of sufficient capacity can be found. If the Boulder Canyon dam is built only to the 555-ft. height it would leave opportunity to develop any of the sites that have been located between it and the Grand Canyon National Park, that is the Bridge Canyon or any of the sites above Bridge Canyon.

All-American Canal—It has been suggested that a survey be made to tunnel through the mountains and reach Imperial Valley at an elevation about 165 ft. higher than the route of the All-American Canal survey. At that time the opinion was that the cost would be prohibitive. I am inclined to think that before construction actually begins it would be a good thing to make such a preliminary survey as would determine the relative costs of the two.

If it were feasible through treaty to secure an abrogation of the contract, so that we would not be continually building up a development down there through our use of the present canal, then I can see that there might be economy in continuing its operation in connection with an all-American canal. But an all-American canal for the higher country, the 250,000 acres of additional land, is a necessity, and it is a necessity if we could not through treaty provide for the satisfactory operation of the existing canal. I think the authorization of both the reservoir and the canal will create a situation that will be favorable to an improvement in the present contract.

Power Generation—I believe that the development ought to include both the construction of the storage and the power plant. I think both should be government properties. By building both the power plant and the storage and having a unified ownership we avert a controversy that would otherwise be inevitable, and by that I mean a difference of opinion as to how the water ought to be delivered from this storage. Its primary purpose is irrigation. To carry out that purpose would require a variable delivery from the reservoir. That does not necessarily interfere with a very large use for power, but to get the maximum use for power would mean a uniform delivery throughout the year. My view is that this ought to be primarily for irrigation, with power incidental; and, being built with that purpose in view, it ought to be under such control as will accomplish that purpose.

Purchasers to Distribute Power — If we build this work for power and storage as related enterprises, then the government can sell that power at the works, leaving it to whoever buys it to distribute it and sell it. That seems to be the simplest method of construction and operation.

Restoring St. Paul's Cathedral, London

The authorities in charge of St. Paul's Cathedral in London have been served with a notice to the effect that the edifice is unsafe. The trouble is due to the cracking of the piers, eight in number, which support the dome, the trouble arising through subsidence. A committee of engineers is investigating the condition of the piers and will recommend what steps must be taken to reestablish the safety of the building. In the meantime this committee has recommended that the cracks be filled with grouting, which is being done. The London *Times* has opened a fund to meet the costs of restoration, and in two weeks this fund has reached £200,000.

From Job and Office

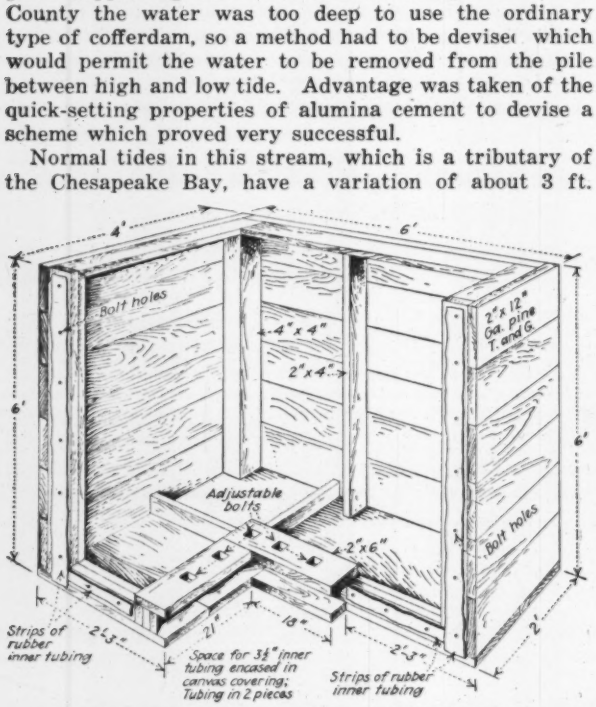
Hints That Cut Cost and Time For the Contractor and the Engineer

Building Up Disintegrated Piles With Quick-Setting Cement Mortar

By Austin F. Shure
District Engineer, Maryland State Roads Commission, Chestertown, Md.

When the Maryland State Roads Commission repaired the disintegrated portions of the concrete piles supporting the Miles River Bridge in Talbot County the water was too deep to use the ordinary type of cofferdam, so a method had to be devised which would permit the water to be removed from the pile between high and low tide. Advantage was taken of the quick-setting properties of alumina cement to devise a scheme which proved very successful.

Normal tides in this stream, which is a tributary of the Chesapeake Bay, have a variation of about 3 ft.



HALF-SECTION COFFERDAM IN PERSPECTIVE

between high and low water and within this area the corners and face of some of the piles had disintegrated to a depth of as much as 2 in. in places, exposing the reinforcement. There was no wasting away of the piling however, above or below the range of the tide.

These piles are 18 in. square and the tops are about 5 ft. above the water surface at normal tide, supporting concrete caps carrying the floor slab of the bridge.

The limited amount of headroom therefore had to be considered also and in order to take care of these conditions a watertight box was built in half sections, like the attached sketch, using 2-in. tongue-and-groove lumber with a wooden frame or casing in the bottom to permit the use of an inner tube. This tube was made up in two sections and threaded into the wooden casing through a canvas covering which was tacked to the casing. Small rubber tubes were attached to this inner tube of sufficient length to permit the inner tube to be pumped up from the water surface after the box was sunk into place.

The half sections of the box were floated into place, bolted together and sunk to the required depth. Sinking was facilitated by pumping water into them from the outside. They were then braced from the pile and from the bottom of the bridge, the inner tubes pumped up and the water pumped out of the box.

The face of the pile was scrubbed clean with wire brushes and a wire mesh reinforcement wrapped around the pile. This reinforcement was placed about flush with the face of the pile. Wooden forms were then built around the damaged portion of the pile about 2 in. outside of the face of the pile all around. This form was filled with a cement mortar made up of one part alumina cement and two parts sand.

The water was kept off of this work from one-half to two hours and in about 15 hours the cofferdam was again pumped out, bolts removed, forms taken off of the new work, the air released from the inner tubes and the box removed.

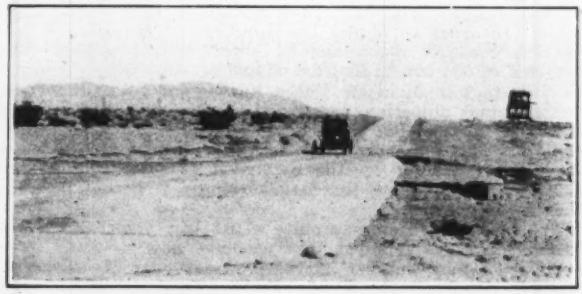
At first some difficulty was experienced with the inner tubing. The sharp edges and shells around the pile would cut it but this condition was corrected by having the edges of the wooden casing come as close to the pile as practicable and by using several thicknesses of heavy canvas as an inner casing for the tube.

When the forms were removed from this work, the cement was thoroughly set and while 22 piles were repaired in this manner during the late fall not one of them shows any indication of having been damaged.

Four men, one small lighter and one centrifugal pump with a 3-in. discharge were used in handling this work and they completed an average of one pile a day.

"Dips" Take the Place of Bridges on Paved Road in Desert Foothills

On the west side of Imperial Valley in Southern California the desert is rimmed by precipitous barren slopes from which great quantities of sediment are brought down whenever enough rain falls to cause a flow of water in the steep gullies and channels that empty out on the desert floor. Ages of erosion have built up debris cones all along the base of these hills



ONE OF THE "DIPS" IN IMPERIAL VALLEY
Note that channel cutting occurs even when flow is of small volume. The downstream side of the pavement is at the right.

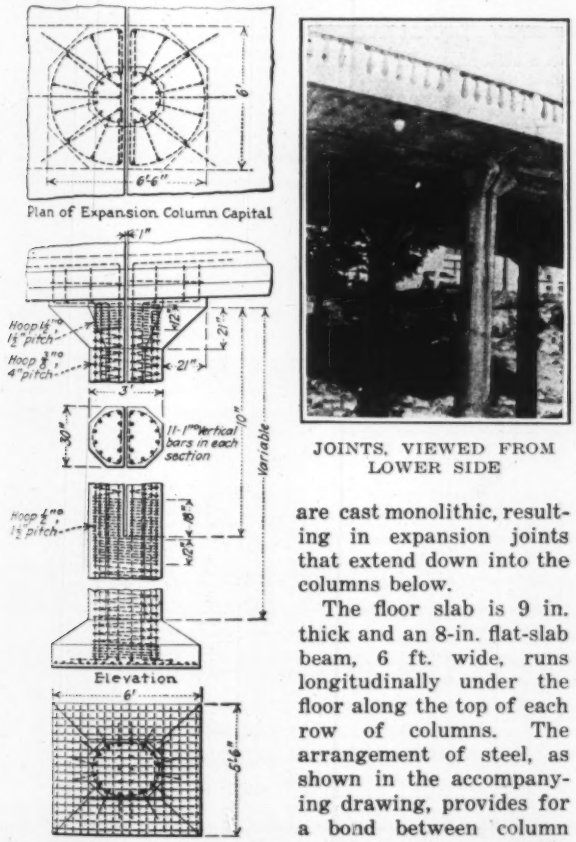
and over these cones the channels often change as further erosion or deposit of material occurs.

The California State Highway Commission in building a concrete paved highway along the foot of these hills faced the problem of crossing a great number of water-worn channels, some old and some new and many of them quite wide, but none of which carried any water at all except at infrequent intervals and then only for short periods. The cost of bridging these dry waterways would have been prohibitive and was, besides, considered unnecessary because of the short periods (usually only a few hours) when enough water would be flowing to prevent automobile travel. Accordingly, a special construction was devised.

These crossings, known locally as "dips," are merely depressions in the paved roadway made wherever the final location carried the line across the channels, old or new. The only difference between pavement construction in the "dips" and elsewhere along the road was that an apron or lip was put along the downstream edge of the paving in the "dips" to prevent undercutting in times of flood, and a shallow cutoff or inverted curb on the upstream edge to resist undermining.

Expansion Joint in Viaduct Floor Carried Down Into Column

A CONCRETE viaduct in Tacoma, Wash., built to carry the ordinary boulevard vehicular traffic, has an unusual feature in that the floor system and columns



DETAILS OF COLUMNS

JOINTS, VIEWED FROM LOWER SIDE

are cast monolithic, resulting in expansion joints that extend down into the columns below.

The floor slab is 9 in. thick and an 8-in. flat-slab beam, 6 ft. wide, runs longitudinally under the floor along the top of each row of columns. The arrangement of steel, as shown in the accompanying drawing, provides for a bond between column and floor system, and the expansion joints in the latter extend entirely across the structure on the columns' center line. This design allows the two parts of the column at the top, which are built as separate members, to separate as contraction occurs and to come closer together with expansion. Because the joint extends 10 ft. down into the column this slight movement is not expected to affect the strength of the column or to weaken it in any way.

The structure was designed by C. E. Manley, former city engineer of Tacoma, and was built in 1923.

Seat Connects Reinforced-Concrete Beams to Steel Members

MORE than one serious accident has been caused by failure to connect securely a concrete beam to supporting structural steel columns. The design of a proper seat for a concrete beam is complicated by the following considerations:

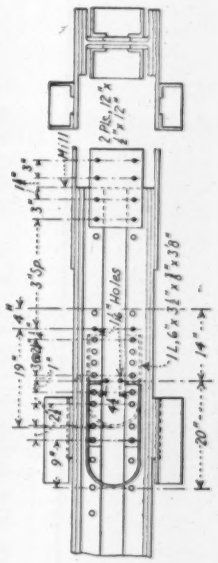
Adequate bearing must be furnished to prevent crushing of the concrete on the bearing surface.

This bearing area, relatively large as compared to that required for a steel beam, must be stiffened to prevent bending or curling.

If the beam is eccentric the problem is still further complicated.

Architectural conditions often require that no bracket be visible below the soffit of the beam.

The hanger seat shown in the figure herewith has been designed to meet these difficulties. It is formed by blocking out a portion of one side of an angle and curving it to an approximate catenary curve. The curve equalizes the pressure on the beam soffit. This seat may be varied in size of bearing area by varying the size of the angle or by the addition of a curved plate. It may be constructed in an eccentric location by the use of a gusset plate as shown in the figure.



CONCRETE BEAM ARTICULATOR SEAT

The seat is the invention of Elwyn E. Seelye, consulting engineer of New York City, who has patented it and named it the "Concrete Beam Articulator Seat."

Controlling Delivery of Asphalt Mixes

BY CREIGHTON D. BICKLEY
Construction Engineer, North Caldwell, N. J.

EARLY in the asphalt paving season of this year the Standard Bitulithic Co. of New York began to run six different bituminous mixes from the Newark (N. J.) plant. A truck backing under the discharge gate was designated to carry one of these six mixes depending upon the job to which it was assigned. A simple and sure method had to be devised to inform the operator proportioning ingredients the type of bituminous paving material to be carried.

To make this communication a simple device was rigged up. A frame 16 in. x 18 in. was constructed from 1 x 2-in. furring lath and placed upon the side of one

of the buildings and in full view of the mixer operator. Through an opening at one end of this frame a 14 x 16-in. card was slid bearing the designation of the mixture to be made (Binder, Top, Topeka, etc.). Directly over the frame an electric lamp was placed to illuminate the sign during the early morning hours.

As each truck took its place under the hopper and the driver was given his destination, the man on the mixing platform, was informed, by glancing at the card in the frame, the mix it was to carry.

The device was designed and constructed by John Howarth, plant superintendent.

Record Keeping on Highway Building

By Frank E. Harley
Assistant Civil Engineer, N. J. Highway Commission, Dover, N. J.

A SYSTEM of keeping records on highway work is shown in the attached sketches. The regular engineering field books are used. In "A" is shown a form to record allowance on classified excavations, providing for earth and rock and showing amount withheld for final cleaning up of ditches and shoulders. This record permits a close check on amount allowed and readily permits of getting at the total amount allowed to date and the amount withheld.

From Job and Office

Hints that Cut Cost and Time

In "B" is shown a form to record the individual items of the contract, as taken from the daily reports. This record shows, station by station, the amount completed, the total finished and unfinished. If special information is needed, as in concrete pavement, special columns may be added, as bags used, required, etc. From this record the periodical estimate can be compiled with the least amount of work and with accuracy.

In "C" is shown a final form of record that may be kept, which gives all the data of the work by periods in a classified form. On the left hand side of the page are placed the detailed items, on the right hand side is shown the contract amount, and any extras or reduction in the contract amount can be taken care of. This latter record also shows the status of the work for any period, by comparing the amounts of completed with the contract amount.

This set of records enables the work to be kept up to date in a simple manner and has the advantage of giving a complete statement of the work, finished and unfinished, without a great deal of labor.

"B" EARTH EXCAVATION TOTAL 25,000 cy

DATE	STATION	TO STA.	AMOUNT	COMPLETED	UNFINISHED
3/4/24	120 + 0	121 + 0	200	2,460	22,540
5	121 + 0	122 + 50	350	2,810	22,190
6	122 + 50	124 + 0	300	3,110	21,890

CONCRETE PAVEMENT CLASS "X" Total 11,000

DATE	STA	TO STA	SQ YDS	COMPLETE	UNFINISH
6/5/24	120 + 0	125 + 0L	500	5,500	6,000
6/6/24	125 + 0	130 + 0L	500	6,000	5,500

"A"

STA	VOLUME	EARTH	ROCK	WITHHELD
120 + 0				
	200	100 + 25	25 + 10	40
+ 50		+ 50		
	300	100 + 50	25 + 35	40
121 + 0				

LENGTH	BAGS USED	BAGS REQD	OVER	SHORT	SLAB NO
500	830	813	17		24-31
500	810	813		3	31-39

"C"

CONCRETE PAVEMENT, CLASS X June 15th

120 + 0	- 150 + 0 L			3,000 sy
1 + 0	- 15 + 0 R			1,500 "
8 + 75	Int. Main Ave.		July 15th	175 "
			4,675	4,675 "

EARTH EXCAVATION May 15th

120 + 0	- 145 + 0	(6000) 50%		3,000 cy
100 + 0	- 115 + 0	(5000) 50%	June 15th	2,500 "
			5,500	5,500 "
120 + 0	- 145 + 0	(3000) 90%	2,700	
			8,200 cy	

Contract amount	11,000 s. y.
Extra Order #5 6-1-24	600 "
Total	11,600 "
Reduction O #4 6-2-24	100 "
	11,450 "
Contract amount	25,000 c. y.
Extra Amount #1 5-15-24	1,000 "
	26,000 "

FORMS FOR RECORDING PROGRESS OF ROAD CONSTRUCTION

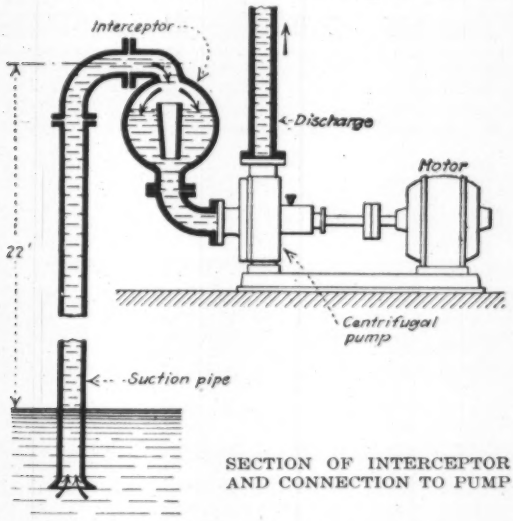
From Job and Office

For Contractor and Engineer

Interceptor in Suction Line Serves as Centrifugal Pump Primer

MOST engineers are familiar with the difficulties often encountered in starting up centrifugal pumps when they are located very much above the water they are lifting. Whenever possible, such pumps are operated "drowned" but this is not always possible with the result that water has usually leaked away through the foot-valve and left the casing full of air.

In this connection a device known as an interceptor installed at one of the London, England, power stations



SECTION OF INTERCEPTOR AND CONNECTION TO PUMP

will prove of interest. The drawing shows the device which is interposed between the centrifugal pump and the suction line, enabling the pump to be started up without any preliminary priming irrespective of the suction lift. This pump lifts water from a dirty water sump 22 ft. below, discharging into an overhead tank.

The interceptor consists of a closed steel plate cylindrical vessel located on the suction line and somewhat higher than the latter, the inlet to the device being at the top and the outlet at the bottom. Between these two orifices is fitted a conical pipe as shown in the end view of the interceptor. Before the pump is started up the upper end of the discharge pipe and the whole of the suction pipe are full of air, the only water being that in the centrifugal pump itself and in the interceptor. When the pump is put into operation it derives its water from that in the interceptor, thus creating a partial vacuum in the suction pipe. This vacuum causes the water to rise in the suction line, and the dimensions of the interceptor are such that water from the sump starts flowing into it before it has been emptied of its primary water by the pump.

The water from the suction line, passing into the interceptor, operates as a kind of ejector, taking with it some of the air through which it passes before entering the cone. Very soon practically all the air which was in the suction pipe has been taken through the pump, and the interceptor is nearly full of water, which is the usual state when the pump is running. When the pump is stopped the water runs back until the level in the discharge line is the same as that in the interceptor, the air remaining in the latter being sufficient to prevent any siphoning action; the vacuum is broken and the water in the suction line runs back into the sump, leaving both the pump and the interceptor full of water.

With the aid of this device no difficulty at all is experienced in operating the pump, which starts as easily as if it had been drowned.

Furnishing Water to Boilers in Cold Weather

By Sutton Van Pelt
Superintendent, L. E. Myers Co., Monticello, Ind.

CONSIDERABLE difficulty is experienced at times in winter construction work in furnishing feed water to steam shovels and other construction equipment. Particularly is this the case in those climates where temperatures as low as 30 deg. F. below zero are frequently registered during the winter months. Some time ago I was connected with the construction of the West Neebish Channel in the St. Mary's River in Michigan, and the fashion in which boiler water was fed to the steam shovels was simple and effective.

There were four shovels and some other boilers which had to be supplied and the problem was to provide boiler water at all times regardless of temperature, which during the months of January and February, seldom rose above the freezing point.

The water-supply plant consisted of one 6,000-gal. wood-stave tank, one 35-hp. boiler and two reciprocating pumps—one a low-service and one a general service pump. Water was supplied to the tank by a pump used for pumping from the sumps. Live steam from the boiler and exhaust steam from the pumps was used to heat the water in cold weather.

Feed water was pumped to the various boilers through 2-in. lines which lay uncovered on the ground. The extreme length of these lines was about 2,500 ft. in one direction and about 5,000 ft. in the other, which, together with feeder lines, amounted to 12,800 ft. of pipe. Lines were laid with as few turns as possible and with few valves so that water always circulated through all branches of the line whenever running. It was never allowed to remain standing in dead ends. During freezing weather, hot water was turned into the lines and kept constantly flowing until the boilers were supplied. Compressed air was then turned into the lines to blow out remaining water in order to leave the pipes practically dry. Ice did not accumulate to any appreciable extent and what small amounts did were melted by the next flow of hot water.

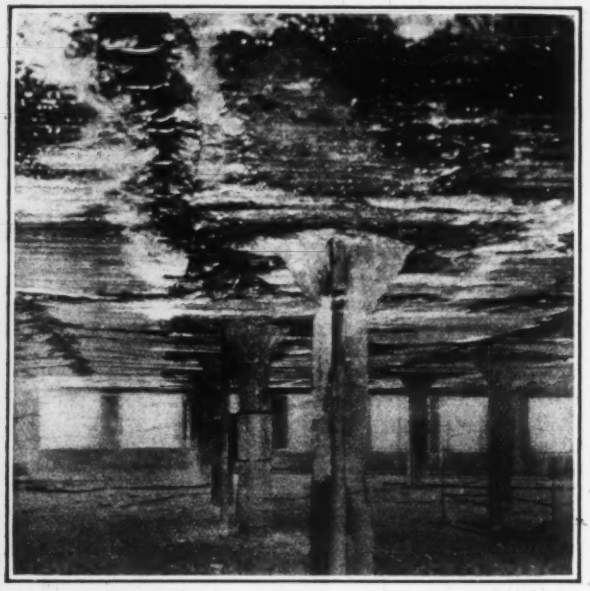
The lines were also piped to receive live steam, but it was never found necessary to use it. The method worked so well that only 2¼ hours per shovel per winter were lost on account of frozen pipe lines. In two seasons' time four shovels lost all told 50 hours of time due to water-supply troubles. Sixty per cent of this loss was from pumps, 25 per cent through freezing and 15 per cent through pipe lines.

The work was done by Grant Smith & Locher Co., C. H. Locher being in charge of the work.

Guncrete Builds Up Slab and Columns Spalled by Fire

IN AUGUST, 1924, the Sterling Products Co., of Evansville, Ind., had a disastrous fire in their warehouse. The building, a four-story concrete structure of the flat-slab type with brick exterior walls, was built for a bottling plant and there were holes through all the floors where conveyors, package chutes, and bottling machines passed through from one story to another. These holes were unprotected by fire stops and the fire quickly passed to all parts of the two upper stories, for the most part filled with crated furniture. By the time firemen reached the blaze the fire had gained such headway that it was impossible to stop it.

Damage to the building was excessive but not irremediable. Columns were spalled to the reinforcing



UNDER SIDE OF FLOOR SLAB BEFORE REPAIR

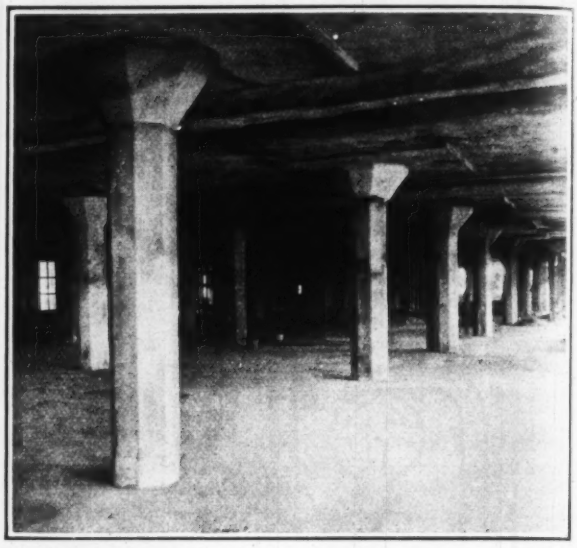
and column capitals and drop plates badly disintegrated. Large cracks also appeared in the roof slab. These cracks invariably followed the construction joints or bulkheads used when pouring the slab.

In order to repair the columns it was first necessary to remove all loose and disintegrated concrete. In most cases this meant taking off everything outside of the spiral reinforcing. In no case was this less than 2 in. This was done with pneumatic chipping hammers. Concrete was then shot against these columns, building them up to their original dimensions. The column capitals and drop plates were also cleaned off and built up in this way to their original dimensions.

In repairing the floor slabs all loose and disintegrated concrete was first removed and the entire underside of the slab cleaned by sand and water-blast. In many places, particularly along construction joints, this necessitated cutting the slabs clear through, thus exposing the reinforcing bars for a width of from 3 to 15 in. Guncrete was then shot in place, replacing all the defective concrete that had been removed and coating the underside of the slab, restoring all surfaces to their original lines.

From Job and Office

Hints that Cut Cost and Time



SLAB AND COLUMNS RESTORED TO ORIGINAL LINES

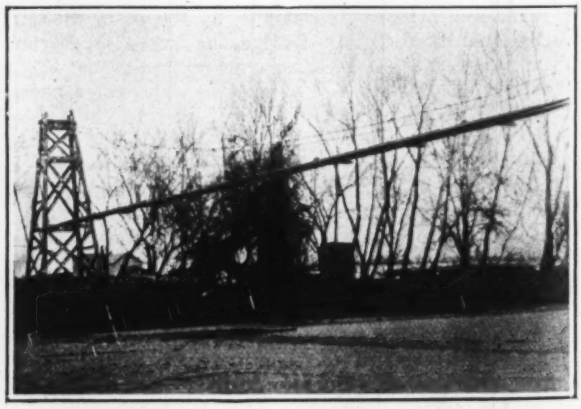
In order to determine the advisability of repairing the building with guncrete, one of the worst panels was repaired by this method and after allowing it to set for 25 days it was subjected to a test load. The results of this test showed the panel to be fully restored to its original designed strength.

The M. J. Hoffman Construction Co. of Evansville, Ind., were the general contractors for this work, the guncrete work being done by the Cement-Gun Construction Co. of Chicago.

Suspension Span Built as Temporary River Crossing for Pipe Line

BY R. O. SHRIVER
Contractor, Salina, Kan.

THE water-supply line for the city of Enterprise, Kan., has been carried over the Smoky Hill River on the highway bridge at this point. A new bridge,



SUSPENSION SPAN FOR WATER-SUPPLY LINE

From Job and Office

For Contractor and Engineer

however, is being constructed; and it was necessary to provide a temporary pipe-line crossing during the construction of the new highway bridge. The mayor of Enterprise asked the writer to suggest a means of providing a temporary line, and this method was devised.

The main cable is ¾-in. wire rope, supported on the timber towers shown and carried back to concrete anchors, a turnbuckle for adjustment being built into each cable at the anchors. The hangers are of ⅜-in. cables, provided with turnbuckles and spaced 10 ft. apart. Clamps on main cables keep them in place. The span, from center to center of supports, is 175 ft., height of towers 28 ft. The sag in the cable is one-twelfth the span.

The cross-pieces on the hangers are 4x6-in. timber; the walkway is of 2x12-in. lumber. It is not supposed to be used as a foot bridge, so the walkway was built lighter than would have been the case if a foot bridge was intended. Side swaying and also vertical movement is guarded against by guy cables to anchors on the river banks. The pipe line itself is 6-in. flanged wrought-iron pipe. The weight of the pipe line, hangers, etc., gives a dead uniform load of approximately 50 lb. per lineal foot.

This may be a trifle more expensive than some other method of handling the problem, but it was thought best to take no unnecessary chance in endangering the only source of water supply for the city.

Telescopic Towers for Aerial Photographing

FOR taking bird's-eye photographs of industrial plants, real estate subdivisions and other subjects where no suitable structure or natural elevation is available, a collapsible tower has been developed which can be carried on a motor truck. This is much more convenient and less expensive than the use of kites to carry the camera or the construction of a special tower at each site. With the sections closed or telescoped the minimum height is 15 ft., with a cross-section 33 x 33 in.; the tenth or smallest section is 10 in. square. The extended height is 125 ft.; there is also a 40-ft. three-section tower for use on roofs or elsewhere.

FIG. 1—MOTOR TRUCK WITH 125-FT. TOWER TELESCOPED

In the bottom section, 33 in. square, the 15-ft. posts are 2½ in. square, each with its interior corner cut away to form a ½ x ½-in. groove for the 2-in. 14-ft. posts of the next section; these latter posts are similarly shaped but for a 1-in. groove, the sides of which are beveled. Above the sixth section the posts are 1½ in. square, with beveled corner grooves. Spruce is used for the posts, cross pieces and latticing, with an iron band

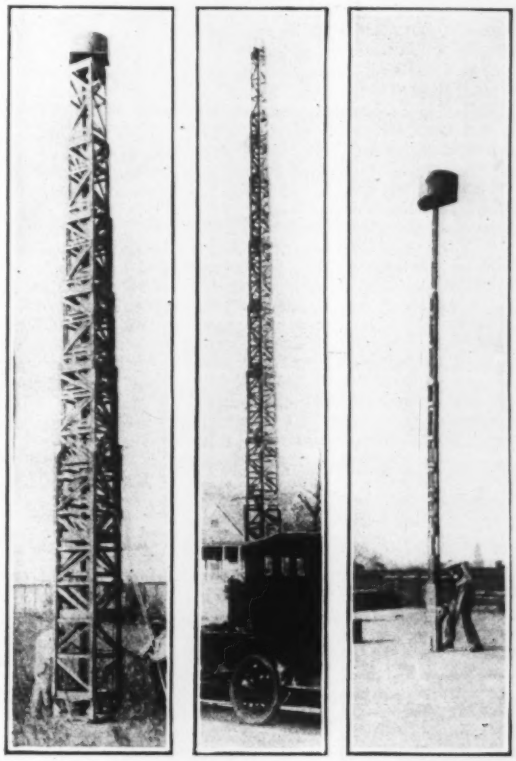


FIG. 2—TELESCOPIC TOWERS FOR PHOTOGRAPHING
At left—tower partly extended. Middle—tower 125 ft. high, 33 in. square at base. At right—post tower, 40 ft. high.

⅛ x ½ in. around the top of each section; brass screws are used, set in drilled holes to prevent splitting. All telescopic sections have ¼-in. maximum clearance.

For raising the second section, the bottom section has a jack shaft 3 ft. from the ground, with two cranks and two sprockets for chains which drive a shaft having right-hand and left-hand worm to operate worm gears on shafts extending to each corner. These shafts carry four sprockets for chains which pass over idler pulleys on top of the first section and are attached near the foot of the interior second section. Each of the other sections is raised by wire ropes attached to its lower edge and passing over idler pulleys on top of the next larger section.

The collapsed tower is first set up on a leveled piece of ground and after being made plumb by means of the guys with block and falls it is secured in position by stakes. The camera, with electric line attached, is then placed on the top section. By turning the crank handles all the sections are raised simultaneously, the upward movement of each one serving to raise the next.

This tower was devised by A. E. Clason of the Kaufmann & Fabry Co., commercial photographers, Chicago.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Responsibility for Errors in Drafting

Sir—In *Engineering News-Record*, Sept. 4, 1924, there appeared an article on a tracer's mistake being responsible for the failure of the concrete wall between the grit basin and sedimentation basin No. 3 of the filtration plant at Sacramento, California, causing a loss of $20,000. This is the first time I ever heard of a **tracer** being responsible for a finished drawing. In most drawing rooms tracers are generally young men and sometimes girls. Very seldom do they have a technical education. It has been my experience in drafting rooms that when a tracing is completed it is checked by the designer as to his own figures, then checked by another engineer as to design and then submitted to the head of the department for approval.

In this case the tracer showed only 25 per cent of the amount of steel called for on the original drawing. The report said, "The drawing passed the inspection and scrutiny of at least five or six capable persons without discovery of the discrepancy." It seems almost impossible for a designer to check a tracing with 75 per cent of the steel omitted and yet not detect the error.

I should not wish to encourage carelessness among tracers, but I do think that in this instance it is a case of shifting the responsibility to one not entitled to it, or "passing the buck." EARL W. MCKEE.

Greenville, Pa., Dec. 29, 1924.

Unfarmed Area of Irrigated Land

Sir—From the reply by R. P. Teele to my letter of Nov. 24, 1924, in reference to irrigation development, both printed in your issue of Dec. 25, it is apparent that the responsibility for the statement in your article of Nov. 13, to which I especially took exception, rests with your paper and not Mr. Teele.

The situation based on Census Bureau data and appearing in Mr. Teele's report stands as follows:

Area irrigated in 1919.....19,191,716 acres
Areas capable of being supplied in 1920....26,020,477 acres
Increase in area irrigated per year from 1909-1919 ..... 470,000 acres

From these data the area irrigated in 1920 with a normal rate of increase was 19,661,716 acres and the idle are in the same year 6,358,761 acres. This area includes idle lands under fully developed projects as well as undeveloped and idle lands on partially developed projects. It has been found that 5 to 15 per cent of the irrigable area of developed projects lie idle every year for reasons not connected with construction or water supply. A parallel to this condition exists in the humid farming sections.

The irrigation census compiled by Mr. Teele shows an irrigated area for the United States, exclusive of Louisiana and Arkansas, of 18,592,888 acres in 1919. Assuming 10 per cent of the developed area idle, this item would amount to 2,066,000 acres, leaving 4,293,000 acres to be charged against undeveloped lands. At the acreage rate of increase for 1909 to 1919 the undeveloped area would be used up in nine years. If, as stated by Mr. Teele, the margin of unirrigated lands under constructed works includes some areas for which works are not complete, the period of nine years is still further cut down.

This differs very materially from the 17,000,000 acres and 35 years quoted in *Engineering News-Record*. The greater part of the area of undeveloped lands is made up of the unimproved fractions of individual holdings.

Development by well-financed agencies with a view to resale of the finished product in the shape of farms to the individual would be able to reduce the margin of undeveloped land. That the margin can be radically reduced does not appear likely, as all projects inevitably contain land of various grades and the poorer will be left for deferred improvement. There are elements of uncertainty regarding engineering, crop production, and markets in every project which only actual operation can settle, requiring leeway in the developed area during the early stages of development. E. B. DEBLER,

Denver, Colo., Engineer, Bureau of Reclamation.
Jan. 3, 1925.

Moment of Inertia in Torsion of I-Beams

Sir—A properly chosen nomenclature is so important in engineering that an attempt to frame clearly the basis of the difference of opinion between Prof. C. R. Young and myself may be of value. Prof. Young's letter in the Dec. 25 issue, p. 1047, brings out this difference.

When Mr. Turner says, in his "Elasticity and Strength of Materials" Sec. 4, as reviewed in *Engineering News-Record*, Oct. 16, 1924, p. 639, "The moment of inertia (in column action) is therefore four times as great as in simple flexure; or when Fischmann and Weirich in their [illegible] excellent discussion of the column problem in *Der Eisenbau*, 1916, p. 266, say that a latticed column must be considered as having an actual moment of inertia lower than the calculated; or when Prof. Young in his recent Bulletin 4, p. 137, says, "The effective polar moment of inertia of these plow beam sections apparently ranges from 32.8 per cent to 61.8 per cent of the tabular polar moment of inertia," I find myself in the position of the reviewers of Mr. Turner's book. I am confused because I do not know just what they mean without considerable study of the accompanying text, and my confusion is increased when I find that Young and Hughes use the term *effective polar moment of inertia* in a different sense than do Gibson and Ritchie in "The Circular Arc Bow Girder."

The terms moment of inertia and polar moment of inertia as used in elastic theory have lost their original kinetic implications and define purely geometrical properties of the cross-section. In special cases (full-walled sturdy columns or beams, or circular shafts) they are simply related to two important characteristics of engineering structures, their stiffness and their strength. When (as in light latticed columns or other than circular shafts) these simple relations do not exist, I can, of course, if I please, choose under certain assumptions to call the corresponding strength constants "effective" or "actual" or "apparent" or some other adjectival moment of inertia or polar moment of inertia. I can, however, as logically call the corresponding stiffness constants, instead of the strength constants, by the same names. Which I shall do depends upon my feeling as to the relative importance of strength or stiffness. If I am particularly fertile in expedients, I might use "effective" for the strength constant and "apparent" for the stiffness constant, or vice versa, and give my readers the pleasure of looking up each time the sense in which I use the words.

It seems to me clearer in these cases to name the constants by names which definitely suggest their actual associations with strength and stiffness. By doing this, confusion is avoided and at the same time there is no possibility of suggesting that the shearing stress is a maximum where it is actually very nearly zero.

Engineers must, of course, depend upon empirical formulas, but to proceed farther along empirical lines than the absolute necessities demand is dangerous, for empirical formulas can be relied upon only for conditions closely similar to those upon which they were based. Usually, the larger the rational basis entering into their formulation, the wider their range of reasonably safe approximation. Thus, if in Young and Hughes' purely empirical formula we double all dimensions of the beam, the value

$$J' = (0.40 + 0.017 \frac{d}{t}) A_w^{1.35}$$

comes out only 5.66 times as great, while the empirically corrected approximation of Föppl

$$J = 1.57 (\tfrac{2}{3} b_1 t_1^3 + \tfrac{1}{3} b_2 t_2^3)$$

comes out 16 times as great, as we should expect from purely dimensional reasoning. Neither, of course, could be expected to work over so wide an extrapolation, but it would seem, then, that the second ought to serve for rough estimates over a wider range of sizes than the first. In any given case, of course, the final answer must be given by experiment. L. B. TUCKERMAN,

Engineer Physicist, Bureau of Standards.
Washington, D. C.,
Jan. 13, 1925.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Reclamation Colony Bill Favorably Reported

Will Improve Prospects and Outlook of Settlers—Farm Experience and Limited Capital Needed

The Senate Committee on Irrigation and Reclamation, in reporting the Kendrick bill, has launched legislation which is regarded as being of far reaching significance to the whole conception of federal aid for the reclaiming of land. If this bill becomes a law it is certain to improve greatly the prospects and the outlook of the settlers, it is declared. The report from the committee, among other things, says:

"The purpose of this measure is to change the plan under which settlers are accepted and under which they undertake their obligations. It does away with the lottery system of securing settlers and in its place proposes a plan whereby certain requirements or qualifications will be exacted with a view and purpose of insuring the success of the settler and, by the same fact, preventing unusual hardship, deprivation, and final disappointment in his efforts to provide himself with a home and farm. Settlers will be selected on a basis of qualifications and must bring to this joint venture between the government and themselves a reasonable amount of farm experience and limited capital.

"Provision is made in this bill to bring into the settlement and development of land under new reclamation projects the benefits of co-operation and teamwork among settlers in doing things they can do as a community better than as individuals and to bring to this development the economies and safeguards that come from expert advice. This is accomplished by placing on each settlement an adviser who can instruct or inform the beginner to whom problems of reclamation are new. Under the community plan settlers will be able to effect co-operative methods that will greatly contribute to the success of their venture.

"In making advances to the settler the plan contemplates not only the success and welfare of the settler in becoming a land owner who actually lives on his land, but the protection of the Government's investment. In increasing the opportunities for successful development of the project we are at the same time insuring prompt repayment by the settler of his obligations to the Government.

"It will be kept in mind that these projects as a rule are located remotely from banking facilities and that the Government holds all the security of the settler. Therefore in extending credit the Government is simply financing a loan so that the settler may make proper progress, promptly meeting his obligations for the purchase of the land, and at the same time making payments on the loan as soon as they fall due.

"The change in conditions created by the Great War, which has practically doubled the cost of water rights and doubled the cost of changing raw land into farms, makes the economies and the advances which this act provides necessary if reclamation is to still be an open door of opportunity for the man of moderate means Its adoption was recommended by each of the five economic boards which studied new projects last year, and that recommendation was indorsed by the five committees of business men who reviewed these reports. It has the indorsement of the Secretary of the Interior and the Budget Bureau. It is believed to be a conservative, economical, and common-sense plan for meeting a problem which confronts reclamation and will create promptly prosperous farming communities where, without it, there would be delay, uncertainty, and loss to many settlers and the Government."

Engineering Fifty Years Ago

From *Engineering News*, February, 1875

COULD a general law be passed making Engineering and Surveying a licensed calling, and placing it it on a footing with Law and Medicine, it would be the initial step toward a better condition of affairs for us as well as for the community at large.

The damage and loss incurred by private individuals, corporations and governments, from faulty work of incompetent surveyors and engineers, is fully equal to that proceeding from the practice of bad lawyers and doctors, and right here may be found a fruitful theme for comment.

Engineering is scarcely rated among the "learned profession"—Surveying is considered a mere trade.

Anyone is accepted as an engineer or surveyor who claims to be such, and no exhibit or diploma is required.

It is the poorest paid of all callings.

Whilst the "contractor" banks his profits by the thousands, the "engineer," who kept zealous watch and ward over him, to prevent fraud pockets his scant salary, with the consoling reflection that he must keep poor to prove his honesty and secure employment. And all this because the profession is unorganized — because there is no understanding among its members — and because they instruct novices in the routine of a certain class of work, which admits them to competition with engineers of a professional education.

Wood Preservers Report Increased Activity

New Zinc-Petroleum Process—Car Timber Treatment—Specifications For Ties and Piles

Publicity as an important factor in increasing the knowledge and use of treated timber was emphasized in the report of the Service Bureau Board at the annual meeting of the American Wood Preservers Association, held in Chicago on Feb. 3 to 5. Reference was made to the recognition of wood preservation as a means of conservation at the recent conference on Forest Products, at Washington; the American Society of Mechanical Engineers has adopted a resolution favoring the increased use of treated timber, while the Southern Forestry Congress has established a wood preservation department. The latest development in the publicity program of the Service Bureau is the appointment of a field engineer.

Specifications for the treatment of yellow pine piles and Douglas-fir ties by pressure processes, using creosote or creosote-tar, were adopted by the Association as submitted by committees. Another report strongly advocated the increased use of treated timber in freight car construction and suggested that car-building companies will eventually establish their own treating plants. Zinc-treated timber can be used for siding, lining roofs, floors and other parts for which creosoted timber is not suitable, but the former must be air or kiln dried after treatment or the water content will interfere with painting. The new zinc-petroleum emulsion treatment was presented in a paper by A. M. Howald, while wood preservation practice in Europe was dealt with by C. M. Taylor.

A large attendance was registered, exceeding 300 members and guests, exclusive of about 100 ladies. Officers elected include: President, S. D. Cooper, assistant manager of treating plants, Santa Fe Ry.; vice-presidents, C. F. Ford and O. C. Steinmayer; secretary, P. R. Hicks, Chicago. It was voted to hold the next meeting at Hot Springs, Ark.

Plan Wider Roads Around Chicago

A system of wider paved roads and more numerous road approaches in the metropolitan region around Chicago is one of the improvements aimed at by the Chicago Regional Planning Association. This project, which is outlined in a pamphlet issued by the association, is being worked out in co-operation with Major Quinlan, county superintendent of highways of Cook County, the Illinois State Highway Department and the U. S. Bureau of Public Roads, and will be governed by the results of traffic surveys made in 1924.

Seattle Council Votes $8,000,000 for Further Skagit Development

The Seattle, Wash., city council has passed an ordinance providing for the issuance of $15,000,000 in city light bonds, of which $8,000,000 is to be used in further development of the Skagit project at Ruby Creek, and $7,000,000 will be expended for extension of electric lines, purchase of five substations, and equipment for the lighting plant. In specifying this development, the city council disregarded the plan of Mayor E. J. Brown and former chief engineer of the Skagit project, C. F. Uhden, who recommended that the next development be at the Gorge Creek unit, entailing replacing the crib dam with a masonry dam. The plan adopted calls for construction of a masonry dam at Ruby Creek, and an additional unit there.

In developing the Ruby Creek unit, construction of the railroad from Gorge Creek to Ruby Creek is planned, which will cost approximately $1,000,000. The development at Ruby Creek will increase the prime power of the Skagit project, and is expected to provide between 75,000 and 80,000 primary horsepower. The present Gorge Creek unit provides 56,000 hp. at high water and 23,000 at low water, which is about half the year.

Plans provide for a storage dam at Ruby Creek, 330 ft. high measured from bedrock to crest located nine miles above the present timber crib dam at Gorge Creek and just below the junction of Ruby Creek with the Skagit, and the extension of the railway, mentioned above, a distance of eleven miles.

The further development at Gorge Creek would have provided approximately 80,000 hp. at high water, with the low-water development remaining the same as at present.

Public Roads Bureau Has Road-Building Slides for Exhibition

Several new sets of lantern slides illustrating methods of constructing various types of roads and suitable for use in highway courses in engineering schools and before technical societies interested in the subject have been prepared by the U. S. Bureau of Public Roads.

Each set consists of from 30 to 50 slides and is accompanied by a syllabus of a lecture to be delivered in connection with their showing. The titles of the lectures are: "Highway Grading," "Sand-Clay, Top-Soil and Gravel Roads," "Bituminous Surface-Treated and Penetration-Macadam Roads," "Mixed-Asphalt Pavements," "Portland Cement Concrete Roads," and "Brick Road Construction."

The slides will be loaned for use on specific dates for periods not to exceed four days, the borrower to pay the cost of transportation, by express, from Washington and return. Reservations will be made in advance, but the Bureau suggests that a second choice of dates be given in order to work out schedules properly. The sets, in most cases, will be loaned one at a time.

Additional Money Appropriated for Muscle Shoals

Among the appropriations carried in the first deficiency act, which just has become a law, are the following: for continuation of work on Dam No. 2 at Muscle Shoals, $3,501,200; for purchase of capital stock of Inland Waterways Corporation, $3,000,000; and for the promotion of safety on railroads, $27,275.

The appropriation for the Wilson Dam is the balance of the amount authorized in 1923. The 1923 act authorized contract obligations of $10,501,200. In addition, $2,000,000 more is to be authorized in another bill for the purchase of transformers.

Right to Let Contract Before Selling Bonds Questioned

A test case to determine whether the City of St. Louis, Mo., can let contracts for public improvements before bonds for the work have been sold is now before the Missouri Supreme Court. The case is based on an ordinance passed Jan. 16 by the Board of Aldermen appropriating $1,600,000 in bonds for Section E of the River des Peres sewer project. City officials hope that they can let the contract and later sell the bonds as funds are actually needed. By this means they expect to save about $2,000,000 in interest on the $87,230,000 bond issue for public improvements voted in February, 1923. This method of procedure would also speed up the completion of the work to be undertaken.

Army Engineer To Serve on Rhine-Danube Commission

Major Brehon Somervell, assistant to the district engineer, First District, U. S. War Department, New York City, has been granted leave of absence to go to Europe as assistant to Walker D. Hines in an investigation of the conditions of navigation on the Danube and the Rhine Rivers. The investigation will be undertaken for the Standing Advisory and Technical Committee for Communications and Transit of the League of Nations. Mr. Hines is to be director of the investigation and selected Major Somervell as his assistant because of the Major's experiences as his assistant on a similar mission relating to shipping on European rivers at the close of the war.

U. S. May Get International Sanitary Conference

A project for an International Sanitary Engineering Conference in the United States in 1926 or later was reported by T. Chalkley Hatton, engineer Milwaukee Sewerage Commission, at the meeting of the Sanitary Division of the American Society of Civil Engineers in New York City on Jan. 22. The division authorized its executive committee to appoint a committee with power to secure American and foreign co-operation for a conference similar to the one held in London in July, 1924.

Lease Developed for Surface Car Subway in Philadelphia

Detailed recommendations for the construction of the surface car subway in Chestnut St. in Philadelphia have been prepared by a committee of engineers consisting of Henry E. Ehlers, director of city transit; S. M. Swaab, city consulting engineer; and Ralph T. Senter, vice-president in charge of engineering for the Philadelphia Rapid Transit Co. The recommendations of the committee are (1) the eastern terminal of the subway shall be a delivery loop approximately at Front St., designed to serve the Pennsylvania Railroad Co. and the Reading Co. ferries and to enable a future connection with the Second St. station of the Market St. subway; (2) that for initial construction, the westerly limit of the subway be a portal approximately between Twenty-second and Twenty-third Sts. in Chestnut St.; and (3) that the subway can be built for $20,000,000 and that low level sidewalks in connection with the subway, to be constructed from Sixth to Nineteenth St. will cost not more than $5,000,000, making the estimated cost of the combination $25,000,000.

The Chestnut St. surface car subway is designed to carry through the central portion of the city the surface cars now operating on Chestnut and Walnut Sts. Its construction was approved by the voters of Philadelphia in September, 1924. The Philadelphia Rapid Transit Co. has offered to pay the interest and sinking-fund charges on the investment, thus enabling the city to proceed with the construction without charging the amount against its borrowing capacity. A proposed lease to secure this arrangement has been prepared in conference between the city and company representatives and has been submitted to Philadelphia City Council for approval.

International Public Works Congress to Be Held at Paris

Under the patronage of the French minister of Public Works, Commerce and Labor there will be held in Paris in mid-June the fourth International Public Works Congress. The program will present for discussion the following: the lodging crisis and the means of effectively combatting it; research which shall lead to lower construction costs; encouragement and development of apprenticeship in the building trades and public works contracting industry; and research of new formulas for application to the execution of large construction enterprises.

The usual visits to important enterprises in the neighborhood of Paris will form a part of the program, including a gala representation at the Opera.

Various excursions farther afield will include a visit to the reconstruction work going on around Rheims, a visit to the workman's garden city of Tergnier founded by the Northern Ry., a visit to Marseilles for inspection of the ship tunnel from the Mediterranean to the Rhône and to the Grenoble hydro-electric exposition.

N. Y. Building Congress Awards Craftsmanship Certificate

The first award for recognition of superior craftsmanship under the plans formulated by the New York Building Congress Committee on Pride of Craft was made Jan. 27, on the new Building Loan Building, New York City. The recipient of this award was Edward J. Murphy, a brick mason. G. A. Martin, president of the Railroad Co-operative Building and Loan Association, for which the building is being erected, said similar awards would be given to mechanics in other of the major trades by the completion of the building. Stephen F. Voorhees, president of the New York Building Congress, made the speech of presentation and signed the certificates.

J. F. Fairlamb, chairman of the board of the Co-operative Building and Loan Association on behalf of the owners stated that each man who does the actual work plays just as an important part in the development of any industry as in any other effort of activity; that a man distinctively sets his own value and that in making his mark he achieves something that is worthy of consideration from every standpoint.

J. J. Collins of the Tunnel and Excavators Union on behalf of labor said that the presentation of this diploma is of interest to every working man as it shows that labor is receiving recognition for its services and he asked the labor element as a whole to support the work of the Building Congress in its developmnet of pride of craft.

The special committee of award for this job acted under the general Congress Committee on Pride of Craft, of which E. J. Mehren, vice-president of the McGraw-Hill Co., is chairman.

Ontario Urges Approval of Plan to Develop St. Lawrence Power

At a conference held Jan. 22, 1925, between Sir Adam Beck, chairman of the Ontario Hydro-Electric Commission, and the members of the Ontario Cabinet it was decided to make representations to the Federal government that Ontario was anxious to proceed immediately with the St. Lawrence River power development. The project has been delayed because the Federal government has not yet given its approval to the plans which have been submitted to them by the Hydro-Electric Commission. (*Engineering News-Record*, Jan. 24, 1924, p. 171.) Sir Adam Beck stated that Ontario was approaching a serious power crisis, as by the end of next year every available horsepower of electric energy would be in use, even without the industrial boom which many were anticipating. Premier Ferguson announced that if the Federal government approved of the plans the construction of the St. Lawrence power plant would be begun immediately and would be completed in four years.

Development of Power Shown in Motion Pictures

A three-reel motion picture which shows the development of power from the early days of steam engines up to the large water and steam plants of today has been prepared by Stone & Webster, Inc. The object of the picture is to explain in a non-technical way some of the fundamentals of power development, to show what has been done in the past few years in developing power, and to predict what developments may be expected in the near future.

Research Graduate Assistantships Offered by Illinois

Applications for research graduate assistantships at the Engineering Experiment Station of the University of Illinois will be received by the director at Urbana until April 1. The University of Illinois maintains six of these assistantships and two others have been established under the patronage of the Illinois Gas Association. These assistantships, for each of which there is an annual stipend of $600 and freedom from all fees except matriculation and diploma fees, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics, or applied chemistry.

Nominations for these positions, accompanied by assignments to special departments of the Engineering Experiment Station, are made by the executive staff of the station subject to the approval of the president of the university. They are based upon character, scholastic attainments, and promise of success in the principal line of study or research to which the candidate proposes to devote himself. Preference is given applicants with practical engineering experience.

An appointment to the position of research graduate assistant is made and must be accepted for two consecutive collegiate years of ten months each, at the expiration of which period, if all requirements have been met, the degree of Master of Science will be conferred.

Baker River Hydro Development Well Started

The Baker River hydro-electric project is being developed near the confluence of the Baker and Skagit rivers in Washington about 110 miles (via transmission line) northeast of Seattle. It includes the construction of a semi-gravity arch-type dam, 245 ft. high, forming a reservoir with a capacity of 70,000 acre-ft., and a short tunnel to convey water from the reservoir to a power house in the gorge below the dam which will contain two 20,000-hp. waterwheels. The ultimate capacity to be installed will be 80,000 hp.

Work was started on this project early in 1924 and up to the end of October the work done included the building of a construction railroad from the town of Concrete, the erection of camps and the installation of complete construction equipment including plants for sand and gravel washing, air compressors, concrete mixing, etc.

At the height of the season a total of about 900 men were employed at the camp and 300 more on the transmission line. Before the winter rains set in enough concrete had been poured in the dam to bring it up to a height of about 16 ft. above the lowest point in the foundations. During the winter months work will be continued, with reduced crews, and in the spring, as soon as water conditions permit, construction will be rushed on a schedule that calls for the completion of the plant by next fall.

BAKER RIVER DAMSITE WITH STREAM DIVERTED

View downstream from railroad bridge across the gorge. Upstream face of dam will be near footbridge in foreground. Outlet from diversion tunnel in background.

Chicago to Be Granted Temporary Diversion

The Secretary of War has announced his intention to hold hearings in Washington the week of Feb. 16 in connection with the request of the Sanitary District of Chicago to divert an annual average of 10,000 sec.ft. of water from Lake Michigan. The Chief of Engineers has recommended a five-year permit to divert 8,500 sec.ft. annual average and 11,000 sec.ft. instantaneous maximum, conditional upon the carrying out by the District of its sewage disposal program, the participation of the District in the cost of lake regulating works and the starting within six months by the city of Chicago of a 90 per cent metering program to be completed 10 per cent each year.

The Secretary has also asked the Attorney General to rule on the Secretary's legal authority to grant a permit for a diversion greater than 4,167 sec.ft.

Street Car Tunnel Proposed for Pittsburgh Traffic Relief

The Traffic Commission of Pittsburgh, in a report to the Mayor and Council, approved the report on Pittsburgh traffic conditions made by Daniel L. Turner and recommends that the city spend the $6,000,000 authorized in 1919 for the construction of a street car subway, and an additional sum of $950,000 for a sub-street built above the subway for the use of pedestrians. The proposed subway crosses the downtown district of Pittsburgh from Chatham St., following the line of 5th Ave. and 6th St. to Duquesne Way. For the present it would be used for street car traffic, but would be built with the idea of being extended at some time in the future as part of an underground rapid transit system.

Project to Tunnel St. Lawrence River at Montreal Revived

Additional railway facilities between the island upon which the city of Montreal is built and the country lying to the south are promised in a bill which has just received its second reading in the Quebec Legislature, and which was presented on behalf of the Montreal Terminal Co. It is asked that "the company may construct tunnels under the bed of the St. Lawrence River through the property of the province, free of all charge," and the bill further states that the company will submit its plans for the construction of a railway tunnel within six months of the passing of the act, and commence the work of construction within six months of the approval of the plans.

Council-Manager Plan Approved by Newark Commerce Chamber

A referendum vote of 5 to 1 in favor of the council-manager plan of municipal government for Newark, N. J., has been cast by the members of the local Chamber of Commerce after a study of various plans by the chamber's Committee on Municipal Affairs.

Michigan Engineering Society Meets at Flint

Two hundred delegates attended the 46th annual convention of the Michigan Engineering Society, the state division of the American Association of Engineers, at Flint, Mich., Feb. 2, 3 and 4. As the program for the meeting was built up around the association's motto, "Make the engineer a more useful citizen," the discussion was of a general educational and civic nature, rather than technical. Each noon day the delegates met with a local civic body.

The Michigan division endorsed the new A.A. of E. program and unanimously passed a resolution endorsing the Temple Bill providing for a new topographical survey of the United States.

Officers for the ensuing year are: President, Clarence W. Hubbell; vice-president, C. E. Palmer; treasurer, H. L. Hudson, and G. D. Clinesmith, Detroit, secretary.

New Highway Association Formed

Announcement is made of the organization of the Association of Highway Officials of the North Atlantic States. The first annual convention will be held at Atlantic City Feb. 25-27. The states included in the new organization are Maine, New Hampshire, Connecticut, New York, New Jersey and Delaware, and the officers are as follows: William G. Sloan, New Jersey highway engineer, president; Paul D. Sargent, chief engineer, Maine Highway Department, vice-president, and A. Lee Grover, secretary, New Jersey Highway Commission, secretary and treasurer. The board of directors includes, besides Mr. Sargent and Mr. Sloan, S. E. Everett, of New Hampshire; J. A. MacDonald, of Connecticut; A. W. Brandt, of New York; and G. D. Buck, of Delaware.

River Commission Proposed for Missouri and Arkansas

A bill has been introduced into the Missouri Legislature calling for the creation of a commission to work out a plan for impounding the flood waters of the St. Francis and Black Rivers which flow through the sunken area of southeastern Missouri and northern Arkansas, and providing for the refunding through federal aid of approximately $30,000,000 already expended for levee and dredging work in that section. Senator Brown who introduced the legislation in the Missouri Legislature proposes that Arkansas pass a similar bill and that the states co-operate in getting Congress interested in the project.

Fall Convention N.E.W.W.A. To Be On St. Lawrence River

By way of variety, the next annual convention of the New England Water Works Association will be held on the St. Lawrence River. A five or six-day trip is proposed, probably beginning on Labor Day.

McAvoy Report Exonerates State Transit Commission

The special report of Judge McAvoy, appointed by the Governor of New York to investigate the affairs of the State Transit Commission in New York City, states that the charges against the commission are without foundation and adds that the persistent refusal of the Mayor and Board of Estimate and Apportionment to adopt proposals for the validation of new routes and to approve contracts for routes already validated in the dual contract of 1913 have completely frustrated provisions for increased transit facilities. The report recommends the speedy completion of the 14th St.-Eastern line and the Nassau-Broad St. line, both of which were included in the dual contract of 1913 and the construction of the Washington Heights line and the Brooklyn Crosstown line, which were validated in 1923. It recommends that the city of New York obtain legislative authority to increase its borrowing capacity for this purpose. Judge McAvoy also recommends the immediate completion of shop facilities already authorized, the extension of station platforms and the operation of more trains in non rush hours as a means of increasing service with the present subways. He recommends that the Staten Island tunnel be built as a rapid transit tunnel and not as a combined freight and rapid transit tunnel as now proposed. Finally, he recommends that the bus lines in New York City, which, according to court rulings, are illegally operated, be required to obtain franchises and certificates of convenience and necessity under the existing laws in order that the city may have a proper income from the operation of the buses and may be able to fix responsibility for their safe operation.

Kansas City to Vote on Council Manager Plan Feb. 24

A new charter for Kansas City, Mo., providing for a city manager and a council of nine members, including a mayor with power to require his fellow councilmen to reconsider ordinances, is to be voted on at an election held Feb. 24. The mayor and four of the other councilmen would be elected at large but all eight of the councilmen would be chosen, two each from four districts with populations as nearly equal as practicable. There would be nine administrative departments—law, works, fire, health, welfare, water, park, finance and personnel—all single-headed except park and personnel. In addition, there would be a trafficways commission, a city plan commission and board of zoning appeals, an art commission, and a board of city trusts. In general, the city manager would appoint department heads and these would appoint division heads, the latter subject to the control of the personnel board. The proposed charter is very detailed as to condemnation proceedings, establishing grades, public improvements procedure, levee districts and flood prevention, assessment and taxation.

Engineering Societies

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, Ill., March 10-12, 1925.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Spring Meeting, Cincinnati, April 22-24, 1925.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Louisville, Ky., April 27 to May 2, 1925.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Orlando, Fla., June 2-5, 1925.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 22-26, 1925.

The New England Water Works Association at its meeting Feb. 10 had papers on "The Electric Pumping Plant of the Kennebec Water District," by Arthur L. Shaw, engineer, with Metcalf & Eddy, Boston, and "Some Results of Pipe Cleaning," by Burt B. Hodgman, of the National Water Main Cleaning Co. The superintendents' topic was "Co-operation Between Fire and Water Departments," led by Thomas E. Lally, assistant engineer, Water Service, Public Works Department, Boston, and discussed by John S. Caldwell, chief engineer, New England Insurance Exchange, and Henry V. Macksey, superintendent of the waterworks at Framingham, Mass.

The Western Society of Engineers' recent subjects have been: Patents, discussed by William O. Belt, president, Patent Law Association, Chicago, Feb. 2; Engineering Contracts, Feb. 9, a discussion of the standard contracts for engineering and construction prepared by the seven national associations. On Feb. 24 the subject will be Planning Chicago's Development, an engineering study and discussion of the future of the city as an industrial metropolis.

The Association of American State Geologists held its annual meeting in Ithaca, N. Y., Dec. 29-31, and elected the following officers: President, Wilbur A. Nelson, state geologist of Tennessee; secretary, M. M. Leighton, state geologist of Illinois; member of executive committee, E. W. Mathews, state geologist of Maryland. The association voted to send a memorial to the President of the United States requesting a liberal support to scientific work.

The Association of Professional Engineers, Canada, at its annual meeting in Toronto, Ont., elected the following officers: Prof. H. E. T. Haultain, Department of Mining Engineering, University of Toronto, president; H. J. Lamb, superintending engineer of the Department of Public Works, Province of Ontario, vice-president; and R. B. Wolsey, registrar and secretary-treasurer.

The Boston Society of Civil Engineers and the other members of the Affiliated Technical Societies of Boston will hold a joint meeting Feb. 20 with a talk on the rapid transit system of New York City, by Robert Ridgway, chief engineer of the Board of Transportation of the City of New York and president of the American Society of Civil Engineers.

Personal Notes

LAWRENCE T. SMITH has resigned his position with the South Park Commission of Chicago to become the structural engineer for Anderson-Meyer & Co., Ltd., at Tientsin, China. Following his graduation from Armour Institute of Technology in 1921, Mr. Smith has been variously employed by the North Carolina Highway Commission, the New York-New Jersey Vehicular Tunnels, the Inland Steel Co., and on the Florence Lake tunnels for the Southern California Edison Co.

ERIK G. W. LINDQUIST, first engineer, hydraulic laboratory, Royal Institute of Technical Sciences, Stockholm, Sweden, is in the United States to study the equipment of hydraulic laboratories in this country. He expects to visit Cornell, Michigan and Wisconsin universities and possibly the University of California before returning to Sweden and would like to visit other laboratories if he has an opportunity. While in the East his address will be 32 Clark St., Danvers, Mass.

EDWARD N. PIKE, consulting engineer, for the past twenty years chief engineer of the New England Structural Co., announces the opening of offices at 200 Devonshire St., Boston, for consulting practice with regard to steel structures, bridges, reinforced concrete, foundations, design of industrial plants, inspection, appraisals, labor saving equipment, and supervision of construction. He is still retained by the New England Structural Co. as consulting engineer.

T. L. SIMMONS, of Ottawa, formerly assistant engineer of the Board of Railway Commissioners of Canada, has been appointed chief engineer of the board. A. K. H. DRURY of Winnipeg succeeds Mr. Simmons as assistant chief engineer.

A. F. BLAESS, engineer of maintenance-of-way, Illinois Central R.R., has been appointed chief engineer. He is succeeded by L. H. BOND, With M. L. BACKUS as assistant engineer maintenance-of-way.

H. R. SAFFORD, assistant to the president of the Chicago, Burlington & Quincy R.R., and formerly chief engineer of the Grand Trunk Ry., has been appointed vice-president of the Gulf Coast Lines, with offices at Houston, Texas.

WILLIAM M. LEES, formerly of the Sperry Engineering Co., has recently taken up employment with John Arborio, contractor and road builder, New Haven, Conn.

F. L. THOMPSON, chief engineer of the Illinois Central R.R., has been appointed vice-president in charge of Chicago terminal improvements.

Obituary

ANDREW J. SWIFT, U. S. assistant engineer in charge of the Chart Division of the United States Lake Survey, Detroit, Mich., died at his home in Mt. Clemens, Jan. 25, 1925, of pneumonia, after an illness of but a few days, aged 54 years. Mr. Swift was born in Flint, Mich., and entered the government service first in September, 1894, his first work being in connection with the resurvey with the St. Mary's River under Joseph Ripley. In 1897 and 1898 he was chief of a topography party in Alabama on the survey of the Warrior River and Five Mile Creek. His next work in 1898 and 1899 was with the Deep Waterway Commission. For a short time in 1904 Mr. Swift was engaged in engineering in the coal fields in West Virginia. After his return to government service with the United States Lake Survey he was in active charge of a field party on hydrographic and topographic surveys on the Great Lakes for several years and in 1920 was made assistant engineer, a title which he held until his death.

Col. THOMAS L. CASEY, retired army engineer, died in Washington, D. C., Feb. 3 aged 67 years. Colonel Casey was born in West Point, graduated from Yale in 1877 and from West Point in 1879. He attained his colonelcy in 1909 and retired in 1912. His work was in the engineering branch of the service and included the direction of many river and harbor improvements. He took part in the transit of Venus expedition of 1882 as an assistant astronomer under Professor Newcomb, and was otherwise noted as a scientist. His father, Brig.-Gen. Thomas L. Casey, was chief of engineers from 1888 to 1895.

GEORGE W. SYMONDS, civil engineer, Nutley, N. J., died Jan. 31 at his home as a result of a cold contracted while surveying; he was in his 82nd year. Mr. Symonds was born in Oxford, N. Y., went to Oxford Academy and then to Cornell University from which he graduated in 1873. For many years he was town engineer of Franklin township, now Nutley, N. J.

EDWARD F. STAHLE, formerly a prominent civil engineer in the reclamation service in Wyoming and also in government survey work, died suddenly at his home in La Jolla, San Diego, Calif., Jan. 3, aged 64 years. Mr. Stahle was born in San Francisco.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Motor Vehicle Registration Makes New Record

For contractors, engineers and manufacturers of equipment and materials, the 1924 motor vehicle registration figures just issued by the National Automobile Chamber of Commerce—reaching the record-breaking total of approximately 17,000,000 motor cars and trucks in the United States—signify a continuing and expanding activity in highway construction and maintenance.

The registration is made up of 15,200,000 motor cars and 1,800,000 motor trucks.

The world registration of motor vehicles is 19,500,000, so that with 17,000,000 the United States accounts for 87 per cent of the total.

During 1924 there were produced 3,280,000 motor cars and 370,000 trucks —making a total production of 3,650,000 motor vehicles during the year. This represents a decrease of 10 per cent as compared with 1923 and an increase of 38 per cent over 1922.

Of a total of 2,914,294 miles of highway in the United States at the end of the year 455,000 miles are improved.

Paving Brick Stock Increasing

Stock on hand in the vitrified paving brick industry jumped more than 10,000,000 brick in December as shipments slowed down due to the winter season and manufacturers began to stock for early spring shipments, according to the monthly statistical report of the National Paving Brick Manufacturers Association. Twenty-four companies representing 62 per cent of the total tonnage of the industry reported their plants operating at 75 per cent of their normal monthly tonnage capacity.

Production dropped from 27,078,000 brick in November to 23,000,000 in December. Shipments showed their seasonal nature for most of the industry when they declined from 22,833,000 to 9,207,000. Unfilled orders the last day of December amounted to 44,059,000. Of these Ohio is booked for 14,000,000 and Texas for 10,880,000.

Western Brick Men Elect Officers

The Western Paving Brick Manufacturers Association, at its annual meeting in Kansas City, Jan. 23, elected officers for the coming year as follows: President: G. E. Mosher, Coffeyville Vitrified Brick & Tile Co., Coffeyville, Kan.; vice-president: W. L. Barr, Moberly Paving Brick Co., Moberly, Mo.; treasurer: Mrs. Marie Heiney, Kansas City; secretary: G. W. Thurston, Kansas City; governor for National Association: W. L. Barr; alternate governor: M. M. Bushong, Metropolis Paving Brick Co., Pittsburgh, Kan.

16,000 Attended Road Show

According to figures announced by Lewis S. Louer, chairman, registration committee, American Road Builders' Association, the registered attendance at the Good Roads Show in the Coliseum, Chicago, Jan. 5-9, totaled 16,000 names.

Eastern Brick Makers Elect

At the annual meeting in New York, Dec. 9, the Eastern Paving Brick Manufacturers Association re-elected the following officers: President, R. L. Winslow; vice-presidents, C. C. Blair, John W. Hall, W. W. Cunningham, and F. R. Stowell; treasurer, R. T. Hutchins; secretary and chief engineer, William C. Perkins; alternate governor, D. R. Potter. C. P. McFadden was elected governor to fill the vacancy caused by the resignation of C. P. Mayer.

Valve Patent Upheld

The U. S. Circuit Court of Appeals for the Sixth Circuit has affirmed the decision of Judge Westenhavor in the U. S. District Court for the Northern District of Ohio, upholding the Johnson patent No. 1,030,890, owned by the William Cramp & Sons Ship & Engine Building Co., and holding that the patent is infringed by the balanced valve manufactured by the Wellman-Seaver-Morgan Co. of Cleveland.

The type of valve involved was that installed by the I. P. Morris department of the Cramp company at Niagara Falls and many other hydraulic power plants throughout the country for controlling the flow of penstock water to the turbines. The defendant's valve was alleged to differ from the valve of the Johnson patent in exhausting a large part of the pressure to atmosphere instead of into the conduit, and in other particulars. The District Court had held these differences to be immaterial.

Business Notes

F. A. MERRICK, vice-president and general manager of the Canadian Westinghouse Co., of Hamilton, Ont., Canada, has just been elected vice-president and general manager of the Westinghouse Electric & Manufacturing Co., according to an announcement made by E. M. Herr, president. Mr. Merrick who will have general executive charge of the activities of the Westinghouse organization at East Pittsburgh, Pa., assumed his new duties Jan. 1. The new vice-president and general manager is a native of New Jersey and received his technical education at Lehigh University. Shortly after graduation he was employed by the Steel Motors Co., a subsidiary of the Lorraine Steel Co., where he was responsible for many important electrical inventions and rose to the position of chief engineer. Later he joined the Westinghouse company, at East Pittsburgh, where he had charge of the production of street railway motors. After the formation of the Canadian Westinghouse Co., Ltd., in 1903, he was sent there as superintendent, and later became manager of works, and finally vice-president and general manager.

FULTON IRON WORKS, Co., St. Louis, Mo., has appointed A. G. Wright to take charge of its branch office in Dallas, Tex. Mr. Wright has had a long experience in the Diesel engine field and was formerly on the sales staff of McIntosh & Seymour. Since 1918 he has been engaged in the contracting business in Dallas.

PUROX CO., Denver, Colo., manufacturer of welding and cutting apparatus, is completing work on two acetylene plants, one at Los Angeles and the other at Oakland, Calif., through which it will be able to supply customers on the Pacific Coast.

T. L. SMITH CO., Milwaukee, has appointed as its distributors the Pacific Hoist & Derrick Co., 818 First Ave., South, Seattle, Wash., and D. C. Elphinstone Co., Inc., Continental Bldg., Baltimore, Md. Both of these companies will carry a complete line of the Smith tilting, non-tilting and paving mixers.

NORMA-HOFFMANN BEARINGS CORPORATION, Long Island City, N. Y., manufacturer of ball, roller and thrust bearings, announces that its factory and general offices have been moved to the new plant at Stamford, Conn. The Long Island City office has been discontinued and all shipments will henceforth be made from the new Stamford plant.

NORTHWEST ENGINEERING CO., Chicago, builder of gasoline and electric convertible crawler cranes, shovels and draglines, announces the addition of E. L. Sparks to its sales staff in the Philadelphia territory. Mr. Sparks was employed for a number of years by the McGraw-Hill Co., publisher of *Engineering News-Record*, and while a member of its staff wrote the Bill Muldoon ad's for the Erie Steam Shovel Co. He later entered the employ of the Erie Steam Shovel Co. and was with that concern for six years. The last year he has devoted to serving the Ohio Locomotive Crane Co.

INDEPENDENT CONCRETE PIPE CO., Indianapolis, announces the opening of a branch office in Chicago under the name of the Illinois Concrete Sales Co. Frank Novotny is in charge.

BELLE CITY MANUFACTURING CO., Racine, Wis., has acquired the exclusive manufacturing and sales rights to the Johnson Trackpull, a crawler device for a Fordson tractor hitherto controlled by the A. C. Johnson Products Co. F. L. Norton, formerly vice-president and general manager of the J. I. Case

Threshing Machine Co., and C. L. Russell, who has been in charge of sales for the Johnson company, have joined the Belle City organization. The company has developed a new and improved type of Trackpull which will be announced within a few weeks.

TOWMOTOR CO., Cleveland, Ohio, manufacturer of industrial haulage equipment, has entered into a receivership.

STANLEY H. ROSE, who has for the past 8½ years held the position of foreign sales manager of the Barber Asphalt Co., Philadelphia, will associate himself on Jan. 1, with the American Creosote Works of New Orleans, La., as Eastern sales manager of its creosote oil department. In addition to this, Mr. Rose will act as general sales agent for the Savannah Creosoting Co., Savannah, Ga., in the sale of creosoted lumber, poles, piles, railroad ties and timbers. After Feb. 1, and until further notice, Mr. Rose will make his headquarters at the registered office of the American Creosote Works, Annapolis, Md.

CRESCENT BRICK CO., Pittsburgh, Pa., which purchased at public auction in August the Mack Manufacturing Co., of Wheeling, Va., producer for 35 years of the Mack paving brick and block, announces that the plants acquired were put in operation in September and are now in a position to make shipments. The Central Clay Products Co., Wilkes-Barre, Pa., is the exclusive distributor for the new owners of the Mack brick in the United States and Canada. R. T. Hutchins, formery vice-president and sales manager of the Mack company, is president of the distributing company.

GEORGE R. ELLIS has tendered his resignation as manager of sales in the specialty department of the Niagara Alkali Co., Niagara Falls, N. Y., to take effect March 1. Mr. Ellis has been connected with the Niagara Company and its associate company, the Electro Bleaching Gas Co., for over twelve years, and was for a long period the Western representative for the latter company with headquarters at Chicago. During that time he was successful in introducing liquid chlorine in the waterworks field when that commodity had stubborn resistance.

LAKEWOOD ENGINEERING CO., Cleveland, announces that in the Philadelphia territory the distribution of its paving and general construction equipment is handled, effective Jan. 1, by J. Jacob Shannon & Co., 1744 Market St., Philadelphia. The distributing company has a field force of 14 men covering the territory.

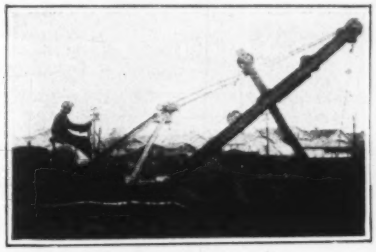
UNIVERSAL CRANE CO., Elyria, Ohio, has recently appointed the following distributors: For the State of Florida, McDonald & Burgman, Daytona, Fla.; for Georgia, G. W. Van Keppel, Atlanta; for South Carolina, Fred. D. Marshall, Inc., Seaboard Park, Columbia, S. C.

CHARLES V. ROBERTS, president, Roberts Filter Manufacturing Co., Darby, Pa., died Dec. 22.

Equipment and Materials

Light Excavator Offered in Four Models

To handle that class of excavation or material-handling work which is not large enough to warrant investment in expensive heavy-duty plant, the Insley Manufacturing Co., Indianapolis, has placed on the market four models of its gasoline excavator, rigged as a power shovel, a skimmer scoop, a ditcher, and a crane. With a ½-yd.



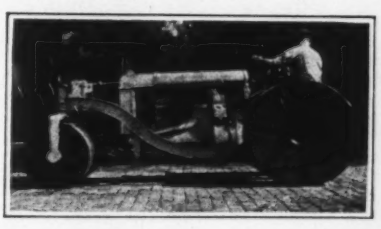
bucket the machine, its manufacturer states, has a capacity of from 200 to 500 cu.yd. daily.

The mounting is on chain-driven crawlers which can turn in an 18-ft. circle, and the width of 8 ft. 6 in. makes the use of outriggers unnecessary. Power is supplied by a four-cylinder, 4 x 5¼-in. Buda gasoline engine with Eiseman magneto and impulse starter. Ball bearings are used throughout except on the drums, which are bronze bushed, and on the crawler sprockets, which are babbitted. All bearings are fitted for pressure lubrication.

As a shovel, the machine is used for grading streets and roads where a cut of 12 in. or more is required. It is also recommended for handling various kinds of loose material, such as sand and gravel in dry pits. The skimmer scoop is for light street and road grading where a cut of 6 to 18 in. and an accurate grade are desired. The ditcher is for any sort of digging extending below grade, such as sewers, drainage ditches, basement excavation and stripping. The crane, an attachment having two main hoisting drums and a third drum for the boom line, handles 3,000 lb. on a single at an 18-ft. radius. All of these attachments are interchangeable.

A Light Gasoline Roller

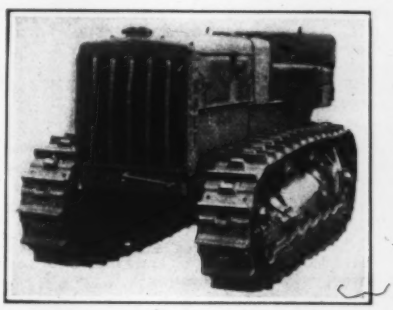
Weighing 6,700 lb. and powered by a Fordson gasoline engine, the Winchell 3-4-ton roller, manufactured by Horst & Strieter Co., Davenport, Iowa, is designed for use on road and pavement construction and maintenance. It is a three-roller machine with a framework of 5-in. channel steel and a rolling width of 62 in. The turning radius is 19 ft. and the weight of the machine is distributed 2,700 lb. on the front rolls and 4,000 lb. on the rear rolls.



The front roll is made up of four sections each 10½ in. wide. The rear rolls are concrete-loaded Fordson wheels. Steering is done by a differential worm and worm gear. The machine has speeds of 1.48 and 2.73 miles per hour forward and 2.61 miles per hour reverse. This roller is recommended by its manufacturer for compacting subgrade, pulling a subgrade machine, rolling brick pavement, and other miscellaneous construction and maintenance purposes.

Improved Features on New 5-Ton Caterpillar Tractor

A new 5-ton four-cylinder caterpillar tractor in which one of the features is a unit form of construction has just been announced by the Holt Manufacturing Co., Peoria, Ill. Three units, (1) motor, (2) transmission, and (3) roller trucks with tracks, form the complete tractor. The weight of the motor and transmission is carried on the roller trucks on a three-point full spring mounted suspension and the roller trucks are propelled through a drive link operating on a pivot shaft attached through the central part of the transmission. The roller trucks



are not hinged and do not pivot about the drive sprocket shaft.

On this machine all clutches are operated by foot pedals. An automatic track release, built into the roller trucks, allows the center of the drive sprocket and track idler to approach so that the track can slip over the sprocket should an obstruction gain access to the track unit. Lubrication has been reduced to a minimum number of points: 2 grease cups, 16 points requiring fluid oil, and 4 points requiring occasional replenishment.

The normal rating of this tractor is 25 drawbar horsepower and there are three speeds forward (1.75 to 4.25 miles per hour) and one reverse. The machine weighs 10,400 lb. and has the following overall dimensions: Length, 10 ft. 4 in.; width, 5 ft. 1 in.; height, 5 ft. 5½ in.; ground clearance, 12½ in. The length of ground contact of the caterpillars is 6 ft. 3 in. and the width of track 12 in. For operating stationary power machines a power pulley

can be fitted at the rear of the transmission, giving a belt speed of 3,500 ft. per minute.

Small Tilting Mixer Has Batch Capacity of 2½ Cu. Ft.

For contractors who specialize on small jobs the T. L. Smith Co., Milwaukee, has placed on the market a new small tilting mixer with 2½-cu. ft. batch capacity known as the Mascot, claimed to be the smallest tilter ever made. It weighs 730 lb. and is mounted on a two-wheel trailer frame for portability. All-steel construction, electric welding, gear-drive and end-to-center mixing action are features of the machine. Because of the double-cone two-

opening design it is only necessary to tilt the drum 45 deg. for discharge, and the tilting is accomplished from either side of the mixer by means of a tilting lever that slides back and forth and is lifted or depressed by hand. The charging opening is low and a charging hopper, supplied on the Smith tilter, serves as a rest for the sack of cement when splitting it, giving faster and less wasteful handling.

The machine has cut gears, electric steel drum pinion, chilled iron thrust rollers—all rollers with dustproof lubrication. It has steel wheels which may be equipped with either hard rubber or pneumatic tires. It is furnished with 1½-hp. gasoline engine, hopper cooled, with Wico magneto, and all enclosed in a lockable steel house.

Publications from the Construction Industry

Electric Equipment for Cranes—General Electric Co., Schenestady, N. Y., has issued a 32-page pamphlet dealing with the power and control equipment for large electric cranes, including overhead traveling cranes and revolving hammer-head cranes.

Quarry Plant—SMITH ENGINEERING WORKS, Milwaukee, in a 16-p. pamphlet, presents data on typical quarry plant layouts, ranging in capacity from 10 to 325 cu.yd. per hour. A feature of the publication is the use of 13 line drawings, with dimensions, showing representative installations. Accompanying each drawing is a complete list of equipment required for the plant illustrated, and a discussion of the advantages and disadvantage of the particular layout.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Demand Increasing for Steel, Cement, Brick and Other Basic Materials as Spring Approaches

With the Exception of Steel, Mill Operations Are Proceeding With Mid-Winter Slowness—Lumber Buying Light

Steel—Demand is heavy, particularly for this time of the year. Mill operations are at about 85 per cent of capacity as against little more than 40 per cent in July, 1924. The January, 1925, ingot output totaled 4,179,498 tons as against 4,187,942 in March, 1924, the high point of that year, according to the American Iron and Steel Institute.

STEEL INGOT OUTPUT—ALL MILLS IN U. S.

		1924 Tons		1923 Tons
October....		3,111,452		3,577,091
November..		3,107,226		3,134,321
December..		3,551,825		2,863,266
January....	(1925)	4,179,498	(1924)	3,633,639

The total ingot output for 1923 was 43,485,665 tons and that of 1924, 36,645,444 tons. Annually, about 4,840,000 gross tons of steel products of all kinds go into buildings, bridges and other construction, exclusive of railroads, according to *Iron Age*. This is 18 per cent of all steel. Steel products used in railway construction, other than for cars and locomotives, in 1924 exceeded 4,000,000 tons. Thus, *Engineering News-Record's* interest in the steel industry amounts to about 35 per cent of steel production, without counting the steel used in tools and construction machinery. At $55 per ton the value of steel used in this class is $266,200,000.

Lumber—The movement for the entire country, as reported by the principal commercial saw mills for the week ended Jan. 31, was slower than that for the preceding week or the corresponding period in 1924, according to the National Lumber Manufacturers' Association. The following table shows the movement for the three weeks indicated:

	Week Ended Jan. 31, 1925 M. Ft. B.m.	Corresponding Week In 1924 M. Ft. B.m.	Preceding Week In 1925 M. Ft. B.m.
Mills	359	367	371
Production	222,096,411	221,516,195	223,569,435
Shipments	228,867,626	239,331,995	231,575,381
New business	213,284,279	229,147,675	220,062,154

The following figures compare the movement for the first five weeks of 1925 with the corresponding period last year:

	Production M. Ft. B.m.	Shipments M. Ft. B.m.	Orders M. Ft. B.m.
1925	1,023,864,335	1,063,788,886	1,008,713,267
1924	1,010,552,481	1,114,099,419	1,235,175,085
1925	+13,311,854	—50,310,533	—226,461,818

The National Lumber Manufacturers' Association estimates that 40 per cent of the total annual cut of the United States goes direct from the sawmill into general building and construction. This figure is 14,000,000,000 ft. b.m. The average mill price is taken to be $27 per M ft. The total value, therefore, is $378,000,000. No attempt is made here to guess at the proportion of this lumber that goes into residential construction. It may be said, however, that residential work is 35 per cent of the money value of all construction.

Cement—New high records in cement production, shipments and reserve stocks were attained by the cement mills of the country during the year 1924.

While shipments gained 7.2 per cent over those of the year preceding, an increase of 8.3 per cent in output covered the additional demand and left reserve stocks at mills, Dec. 31, 1924, greater than at the end of any year recorded by the Geological Survey.

A total of 148,859,000 bbl. were produced in the mills of the country during 1924, against 137,460,000, in the year preceding. The 1924 demand amounted to 145,747,000 bbl., compared with 135,912,000 in 1923.

The reserve mill stocks now total 13,857,000 bbl., against 10,900,000, a year ago. At no time during 1923 were such heavy reserves carried at the mills.

The heaviest cement consuming states are New York, Pennsylvania, Illinois, Michigan and Ohio. The great bulk of the country's output is produced in the following districts: Eastern Pennsylvania, New Jersey, Maryland, Wisconsin, Illinois, Indiana, Kentucky, Eastern Missouri, Iowa, Minnesota and South Dakota.

Supplementary to the foregoing statistics of the Geological Survey is the report of the Bureau of Foreign and Domestic Commerce, to the effect that the heaviest imports of cement are coming from Belgium, with Norway next and Denmark third. Canada and England are sending small quantities.

These imports are being absorbed, as to quantity, in the order named: Los Angeles, Philadelphia, Porto Rico, San Francisco, Florida, New Orleans, Massachusetts, New York, South Carolina and Rhode Island.

It is estimated that 60 per cent of the annual output goes into engineering construction, with an estimated value at mill, of $291,494,000.

Brick—The common brick industry entered the new year with unusually heavy shipments from yard stocks, compared with a year ago. That the national movement to stimulate construction during the winter months is succeeding to a marked degree, is indicated by the present demand for brick. The following tabulation is compiled from latest reports of the Common Brick Manufacturers' Association, representing about 70 per cent of the total common brick production of the entire United States:

COMMON BRICK MOVEMENT FOR ENTIRE COUNTRY

1924	Burned Brick on Hand M.	Unburned Brick on Hand M.	Brick Moved from Yards During Month M.	Orders on Books M.
Jan. 1	313,696	55,646	66,199	266,914
June 1	223,458	70,802	163,298	394,156
July 1	258,474	72,725	158,753	366,098
Aug. 1	231,182	86,722	149,622	314,588
Sept. 1	261,800	68,138	120,777	256,017
Oct. 1	272,172	61,150	111,846	226,529
Nov. 1	312,061	44,543	135,806	186,977
Dec. 1	319,585	49,596	126,945	179,225
1925				
Jan. 1	354,477	51,162	118,759	202,906

Shipments from yards during 1924 amounted to over 1,495,723,000, for members of the association. With an average value at yards of $14 per M. the total would reach about $30,000,000 for the entire country.

New York City Paving for 1924 Cost Over Fourteen Millions

New York streets paved and repaved in 1924 totaled 130 mi. and cost $14,542,194. The distribution by boroughs was as follows:

	Length in Miles	Cost
Manhattan	15.17	$3,512,460
Bronx	17.96	2,737,842
Brooklyn	59.25	5,150,902
Queens	26.05	2,288,400
Richmond	12.01	852,590
	130.44	$14,542,194

With a population of 6,000,000, the per capita figure is $2.42. At this rate the total for the country would be $271,000,000. The actual figure, according to the Bureau of Public Roads, is $350,000,000. A large proportion of this was let in contracts of less than $25,000, the minimum observed in *Engineering News-Record*.

The street and road total for 1924, as published in *Engineering News-Record*, was $415,216 000.

Bricklayers Average 1,364 Brick per Day in Fifteen Cities

The question as to whether or not the productivity of the building trades mechanic is consistent with his present high rate of wages, is again brought to the front, this time by the Common Brick Manufacturers' Association of America.

In a recent report by the Association, the previous findings of the U. S. Department of Labor are reiterated as follows:

"According to the Monthly Labor Review issued by the United States Department of Labor the bricklayer production in this country is higher than at any time since the introduction of ornamental bonds and joints demanded in modern brickwork. Ethelbert Stewart, Commissioner of the Bureau of Labor Statistics at Washington, recently directed an investigation of labor productivity and costs in certain building trades, in fifteen typical cities. He found Birmingham bricklayers at the top in production and those of Indianapolis at the bottom. The average number of brick laid per man per 8-hr. day in the fifteen cities is 1,364. In all except three cities, namely, Boston, Philadelphia and Indianapolis the production of the bricklayer is far above 1,000 per day, while in Birmingham the average bricklayer places 1,928 brick in the wall each working day."

Ralph P. Stoddard, Secretary-Manager of the Common Brick Manufacturers' Association, in seeking to confirm the findings of the Labor Commissioner, states that "during the days of higher building costs the bricklayer has borne the brunt of the feeling against the building trades in general; for bricklaying is the one trade in which a pat phrase expresses the day's work. Every contractor and building superintendent knows that the work of the other trades is not easily measured. Who but an expert knows what is a fair day's work for a plumber, and how can it be expressed except by a lengthy technical statement? But the phrase 'so many brick per day' is on the tip of everybody's tongue. But, fortunately for the bricklayer, his production is checkable to the last single unit.

"An investigation which this association made disclosed no restriction of bricklayer production by the labor organizations. The number of brick a man lays depends upon the skill and energy of the individual, and the ability of the contractor to organize the job and handle men. Bricklayers are doing a fair day's work, in every way comparable with their record in years past. These Government Bureau figures confirm our own conclusions and show remarkably high bricklayer productivity."

Wage Rates in the Canadian Building Trades

The following table shows current wage rates for building trades mechanics in the principal Canadian cities. This compilation is by the Association of Canadian Building and Construction Industries, Central Chambers, 46 Elgin St., Ottawa, and represents the schedules in effect throughout the several provinces as of July, 1924. There have been no important changes in the rates since the date mentioned.

The Canadian building trades employers organizations differ from those in the United States in that the former have a central or national body at Ottawa with local branches in the various cities, as against the American method of having national, state and local organizations.

CURRENT WAGE RATES PER HOUR IN THE BUILDING TRADES IN CANADIAN CENTRES

	Brick layers	Masons	Marble and Tile Setters	Cement Finishers	Plasterers	Carpenters	Lathers	Painters	Slate and Tile Roofers	Structural Steel Men	Hoisting Engineers	Hod Carriers	Laborers
Nova Scotia													
Halifax	$0.90-1.00	$0.90-1.00	.....	$0.90-1.00	$0.90-1.00	$0.57	$0.57	$0.57	$0.57	$0.60	$0.64	$0.35	$0.25-$0.3
New Brunswick													
Fredericton	.90-1.00*	1.00*	$1.25*	.90*	1.00*	.50-.65	.40	.70	.....	.....	.60	.40	.30-.35
St. John	1.00*	1.00*	.70*	1.00*	1.00*	.50-.60	3.00 per M.	.50-.60	.....	.50-.55	.45	.30-.35	.30-.35
Quebec													
Montreal	up to 1.00	up to 1.00	.70-.75	up to .70	.80-1.00	.65-.75	.50-.65	.50-.70	.55-.65	.60-.90	.50-.60	.37½ & .40	.35
Quebec	.90	.80	.80-.90	.45-.60	.85	.45-.55	3.00 per M.	.42-.60	.45-.55	.65	.50	.40-.45	.40
Sherbrooke	.85	.60	.....	.40	.75	.50	.50	.45	.75	.....	.....	.35	.30
Ontario													
Belleville	.80-1.00	.80-1.00	.....	.75	.80-.90	.60-.75	.....	.65	.....	.....	.....	.40	.30-.40
Brantford	1.00	1.00	1.00	.50-.75	1.00	.80	.80	.50-.65	.50-.75	.....	.70	.45-.55	.40-.50
Brockville	.90	.90	.....	.90	.90	.60-.75	.....	.65-.75	.....	.....	.....	.40-.45	.30-.45
Galt	1.00	1.00	.....	.50	1.00	.60-.70	.75	.55-.65	.....	.....	.75	.45	.35-.45
Guelph	1.10	1.10	.....	.50-.60	1.10	.80	.....	.60	.....	.....	.....	.50	.35-.40
Hamilton	1.12½	1.12½	1.00	.55-.60	1.12½	.80	.75-.87½	.70	.80	.70	.75	.45-.50	.40-.45
Kingston	.85-1.00	.85-1.00	.85-1.00	.75-.90	.75	.75	.65	.65 & .70	.....	.80 & .85	.....	.35-.50	.25-.45
Kitchener	1.00	1.00	.....	.50-1.00	1.00	.60-.90	.70 & .75	.....	.....	.75	.....	.50-.60	.25-.40
London	1.00	1.00	1.00	.65-.80	1.00	.60-.85	.80	.65	.50	.....	.85	.50-.60	.40-.60
Niagara Falls	1.25	1.25	1.25	.70	1.25	.85	8c. per yd.	.75	.75	1.00	.75-1.00	.70	.45-.70
Ottawa	1.10	1.10	1.00-1.10	.50	.85	.75	.75	.60-.75	.75	.75	.75	.45	.45
St. Catharines	1.00	1.00	.....	.....	1.00	.....	.....	.....	.....	.....	.....	.....	.40-.50
St. Thomas	1.00	1.00	.90-1.00	.65	.85-.90	.50-.75	.90	.60-.70	.85	.85	1.00	.50	.40-.45
Sarnia	1.00	1.00	.....	.70	1.00	.70-.80	.70	.65-.75	.....	.60-.80	.70	.50	.45
Stratford	1.00	1.00	1.00	.55-.60	.90-1.00	.50-.65	.60-.75	.50-.70	.60	.50-.60	.....	.35-.55	.30-.55
Toronto	1.25	1.25	1.25 & 1.07½	.70-.90	1.25	.90	1.00-1.12½	.65-.75	.65-.90	.65-.75	.70—.85	.55-.75	.40-.60
Windsor (Border Cities)	1.35	1.35	1.25-1.35	.80-1.00	1.50	1.00	1.25	.85-1.00	.90-1.00	.80-.90	1.00	.40-.70	.40-.60
Manitoba													
Brandon	1.00-1.10	1.00-1.10	.....	.50	1.00	.75	.75	.60	.....	.....	.....	.45	.35-.40
Winnipeg	1.25	1.10	1.05	.70	1.07½	.85	.80	.75	1.10	.90	.85-1.00	.50-.55	.35-.42½
Saskatchewan													
Moose Jaw	1.15-1.50	1.15-1.35	1.00	.60-.85	1.15-1.50	.70-.80	9c. yd.	.70	1.00	.90	.70-.85	.50	.40-.50
Regina	1.25	1.25	1.25	1.00 & 1.20	1.15-1.20	.75	6-9 per yd.	.70-.75	.....	.....	.60-.75	.....	.40-.50
Saskatoon	1.25	1.25	1.25	1.00-1.25	1.25	.70-.75	7c. yd.	.65-.90	.80	.90	.75	.60	.35-.40
Alberta													
Calgary	1.15	1.15	1.10	1.15	1.15	.80	4.00 per M.	.75	.....	1.00	.92½	.65	.40-.50
Edmonton	1.25	1.00	1.00-1.15	1.00	1.15	.80	.85	.80	.....	1.00	.95-1.00	.50	.40-.45
British Columbia													
Vancouver	1.12½	1.12½	1.12½	.75-.87½	1.12½	.87½	1.00	.75	.....	1.12½	.87½-1.00	.62½	.50-.56½
Victoria	1.00	1.00	1.12½	.56¼	1.00	.75	.75	.62½	.90	1.00-1.25	.80	.62½	.50

* Denotes unionized in New Brunswick.

Large Projects in Prospect

The following represent just a few of the big engineering construction jobs on which bids are asked or will soon be called for. Further details are given in the Construction News section of this issue, pp. 75 to 85.

Proposed Work

Office, museum, etc., Albany, N. Y., State Building Comn., $12,000,000.

Hotel and stores, Baltimore, Md., W. Schapiro, and others, $4,000,000.

Store, Baltimore, Md., Hochschild, Kohn & Co., $2,000,000.

Temple, Albany, N. Y., Masonic Hall Assn., $2,000,000.

Bids Wanted On Big Jobs

Hospital, New York, N. Y., Dept. Pub. Welfare, $3,200,000.

Sea Wall, Gulfport, Miss., Bd. Supervs., Harrison Co., $2,000,000.

Office, St. Louis, Mo. Roxana Petroleum Co., $1,000,000.

Subway, 7,200 ft., 4 track, Philadelphia, Pa., Dept. City Transit, calls for bids about Feb. 15.

Large Contracts Let During Week

Office, Newark, N. J., Prudential Insurance Co. to Thompson Starrett & Co., $6,000,000.

Bridge, New York, N. Y., Comr. Plant and Structures to A. McMullen Co., $2,625,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 5, the next on March 5.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb	$3.34	$3.90	$4.15	$3.10	$3.35	$3.07½	$3.15	$3.35	$4.25
Structural rivets, 100 lb	4.25	4.45	4.75	3.50	3.75	4.65	5.00	+3.80	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.40	3.38	3.00	3.25	—3.87½	3.35	3.25	—2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	54.2%	43%	56½%	54.25%	36%	44.7@55.5%	45%	59.49
Cast-iron pipe, 6 in. and over, ton	54.60@55.60	56.00	56.00	+49.20@50.20	55.50	62.00	53.00	65.00	60.00
Concreting Material:									
Cement without bags, bbl	2.50@2.60	2.35	2.05	+2.20	2.42	2.84	+2.61	2.65	1.80
Gravel, ¾ in., cu.yd	—1.75	1.90	2.38	3.00	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd	1.25	1.40	2.00	3.00	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.00	2.83	3.00	1.75	2.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	60.00	34.00	56.00	55.00	39.75	39.75	29.00	—23.50	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	23.00	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	—2.50@2.75	1.45	1.85	1.26	1.35	2.70	1.60	2.80	10.50
Common brick, delivered, 1,000	18.00	10.50	11.60	12.00	15.00	12.00	+15.50	14.50	17.50
Hollow building tile, 4x12x12, per block	Not used	.1004	.0941	.06	.07	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.1004	.0941	.06	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal	+1.24	1.26	1.30	—1.25	—1.27	+1.44	+1.32	1.12	1.11
Common Labor:									
Common labor, union, hour	.75	.30	.....	.82½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.75	.50@.55	.35@.50	.50	.50 — .20@.25	

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93⅜c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.60 for Kelly Island and Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.81). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Conditions Affecting the Market

Price advances and declines are about evenly balanced, so far as building materials in the current market are concerned.

Following the recent downward trend in wages of unskilled, unorganized common laborers in the United States, Canada now reports a similar decline. The minimum rate for common laborers is 20c. per hr. in Montreal as against 25c. formerly.

The principal advances of the week occurred in the West and involved such materials as c.-i. pipe, cement, linseed oil, common brick and structural rivets.

Declines were reported in various parts of the country in lime, gravel, reinforcing bars and fir timbers.

Telegraphic reports to *Engineering News-Record* from the Northwestern fir producing regions, state that numerous large Douglas fir saw mills have reduced cutting schedules to a five-day week. Others are planning this move or will shut down entirely for a brief space, until a revival of demand occurs. Lumber prices in the Pacific Northwest are unstable with decreases imminent. It is evident also that production of other building materials will not increase very shortly despite the heavy building program planned and partly under way.

Yellow pine buying is fairly active in the South and Middle West and restricted in the Great Lakes region.

Ornamental ironworkers, derrickmen and riggers are prepared to go on strike, Feb. 10, in New York City. This move is in sympathy with the strike of steel erectors which began in this city almost a year ago. The action is directed solely against the members of the Iron League who usually operate under open shop conditions. It is feared that a national strike order will be issued. Structural ironworkers have been receiving $1.31¼ per hr. and it is reported that an advance to the regular union rate of $1.50 per hr. is under way.